TYPE

74-17A AUTOMATIC DISPLAY DUAL TIME BASE

Instruction Manual

Serial No. _____

This Plug-In Module is designed for use with the Fairchild Type 766H Series Oscilloscope

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Figure 1-1. Type 74-17A Automatic Display Dual Time Base Plug-In

SECTION 1
TECHNICAL SUMMARY

1-1. INTRODUCTION

PLEASE NOTE

IMPORTANT INITIAL ADJUSTMENTS MUST BE MADE BEFORE OPERATING THIS PLUG-IN MODULE. See Paragraph 2-1 entitled "First Time Operation" in Section 2 for instructions.

The Type 74-17A Automatic Display Dual Time Base Plug-in is designed for use with the Fairchild Type 766H Series Oscilloscope.

Equipped with electronic switching, the Type 74-17A can be operated as a delaying sweep generator or as two independent time base generators. Beam switching provides alternate presentations of one signal at two different sweep speeds or a dual-alternate presentation. If a Dual Trace Amplifier Plug-in is used, Channel 1 input is locked to Sweep A and Channel 2 input is locked to Sweep B (when the Y Plug-in has the channel lock feature). When a delayed sweep is displayed, both the waveform with the brightened sector and the brightened sector expanded to 10 divisions can be displayed alternately on screen. The automatic beam switching feature also provides a normal sweep display and a X-Y plot to be displayed alternately.

1-2. TECHNICAL SUMMARY

The performance specification of this plug-in module is given in the technical summary which follows.

SPECIFICATIONS

TRIGGERING SYSTEM

(Separate facilities for each Time Base are provided)

Trigger Source

A three-position slide switch provides selection of internal, external and line frequency triggering. The Ext setting of the Sweep A SOURCE switch is also used for applying X input signal for X-Y plot

Trigger Coupling

A three position slide switch provides the following selections:

- AC Coupling

  High-pass filter having low-frequency cutoff nominally at 80 Hz. This feature prevents erratic triggering when positioning the pattern vertically and using internal triggering

- DC Coupling

  Direct coupling is provided to optimize trigger sensitivity when very slow waveforms are applied; to maintain the initial reference position of the trace with respect to the CRT scale at a given trigger level setting; and to avoid trigger point variations due to random repetition rate trigger signals

- LF Reject Coupling

  Differentiated Trigger input; high pass filter is provided to reject hum and low-frequency amplitude modulation; low-frequency cutoff nominally 10 kHz

  Signals should rise or fall in less than 100 μSEC in order to pass the filter. This feature assures stable triggering from the dual trace plug-in used in alternate sweep mode. (This prevents the change in dc position level from Channel 1 and Channel 2 from affecting triggering)

Trigger Slope

A two-position slide switch enables selection of positive or negative triggering signals

Trigger Level

The Sweep A&B Trig LEVEL controls have a nominal range of 6 divisions of displayed signal on INT Trigger Source. The Sweep A Trig LEVEL control has a range of ± 5 volts on EXT Trigger Source. The trigger leveling range is extended to ± 50 volts with the use of a 10:1 attenuator (PULL EXT/10). The Sweep B Trig LEVEL control has a nominal range of ± 4 volts on EXT Trigger Source. An EXT/10 attenuator is also provided

Internal Trig Sensitivity

Signals will trigger from 3 millimeters peak-to-peak of vertical deflection signal up to a frequency of 1 MHz. From 5 millimeters peak-to-peak vertical deflection signal up to 10 MHz

External Trig Sensitivity

250 millivolts peak-to-peak from dc to 1 MHz will trigger the sweep. 0.5 volt peak-to-peak will trigger the sweep to 10 MHz. External trigger input impedance is 1 megohm shunted by 40 pf. (Nominal)

Automatic Triggering

A front-panel toggle switch selects either NORMAL, AUTO or HF RECUR triggering for Sweep B only. Auto mode provides a visible line on all sweep ranges when there is no signal input. The sweep free runs until a trigger signal with frequencies between about 20 Hz and approximately 10 MHz is applied. Application of a trigger signal switches the sweep to the triggered mode immediately

HF Recur

A unique high-frequency stability switch may be used to improve count down and lock-in of signals having repetition rate of 5 MHz or greater. It provides stable synchronization of signals of 1 division of deflection to beyond 50 MHz

TIME BASE SYSTEM

(Sweep Ranges Apply to both Time Base Generators)

Calibrated Sweep Range (A & B)

Calibrated linear sweep rates from 0.05 microsecond/division to 2 seconds/division in 24 steps of 1, 2, and 5 sequence

Uncalibrated Sweep Range

The Sweep A & B VERNIER controls provides 2.5:1 independent and continuous uncalibrated range of sweep rates between ranges and extends the 2 secs/div range to 5 secs/div (50 seconds full scale). The UNCAL lamp serves as an indicator of uncalibrated or vernier operation for either or both sweeps

Sweep Accuracy

Normally 1%, always better than 3%

Sweep Expander

A calibrated X10 sweep expander in the X output amplifier will expand the sweep about screen center; extends the fastest sweep rate to 5 nanoseconds/division. Expander accuracy is normally 3%, always better than 5% measured over the centered 8-division portion of the CRT screen. All measurements taken beyond the first 50 nanoseconds or the first division of the expanded sweep time

Sweep Range Controls

Push-pull clutch knob (TIME/DIV controls) permits simultaneous control of the A and B sweep rates and independent control of A Sweep rate

Sweep Calibration

A front-panel screwdriver SWP CAL control is provided to permit normalization of the plug-in unit to the Main Frame

HORIZONTAL DISPLAY MODES

Normal Sweep Operation

- Sweep A or Sweep B

  Conventional sweep display. When using Sweep A only, it is recommended to clutch the two Sweep Range (TIME/DIV) controls together for brighter trace display

- Alternate Normal Sweeps

  Both Sweep A and Sweep B are alternately displayed. The use of EXT Trigger is preferred. AUTO Triggering is provided for both sweeps in this mode of operation. Use of external triggering prevents difference in dc position level between Channel 1 and Channel 2 from affecting AUTO Triggering

Triggered Sweep Operation

- Sweep B Intensified by Sweep A (triggered mode)

  Sweep B display showing Sweep A as a brightened sector of Sweep B. Sweep A (strobe) starts immediately after the delay pick-off trigger is generated

- Sweep A Delayed by Sweep B (triggered mode)

  The brightened sector of Sweep B (indicated in the above mode of operation) is displayed expanded to full scale

- Alternate Triggered Display

  The two triggered modes of operation are displayed alternately on screen. The brightened and expanded sectors can, therefore, be viewed at the same time

Armed Sweep Operation

- Sweep B Intensified by Sweep A (armed mode)

  Sweep B display showing Sweep A as a brightened sector. Sweep A (strobe) is armed by the delayed trigger and initiated by a sync trigger

- Sweep A Delayed by Sweep B (armed mode)

  The brightened sector of the Sweep B (indicated in the above mode of operation) is displayed expanded to full scale

- Alternate Armed Display

  The two armed modes of operation are displayed alternately on screen. The brightened and expanded sectors can, therefore, be viewed at the same time

Single Sweep Operation

- Single Sweep Mode

  The single sweep mode permits but one driven sweep of Sweep A to appear on the screen until

the sweep is reset or rearmed. The single sweep may be REARMED locally by a front-panel push-button switch or remotely through the EXT RE-ARM connector

The Single Sweep REARM indicator is lit whenever the Sweep A gate multivibrator is rearmed and ready to be triggered

The single sweep rate is shown by the Sweep A TIME/DIV setting and may be triggered with or without delay

- Single Sweep with Delay

  Apply the triggering signal to Sweep B input. The delay will be the DELAY VERNIER setting multiplied by the Sweep B TIME/DIV setting

- Single Sweep without Delay

  Apply the triggering signal directly to Sweep A input

X Amplifier Operation

- X Amplifer

  For X-Y displays X Input signals may be applied to X Amplifier via EXT setting of the Trigger A SOURCE switch and preferable "+Slope"

  Alternate, Sweep B and X Amplifier

  Normal Sweep B and X-Y plot are displayed alternately

CALIBRATED DELAY TIME SYSTEM

- Delay Vernier Control

  A ten-turn precision potentiometer determines the on-screen distance from the delaying sweep (B) start at which the delayed sweep (A) is either triggered or armed

  The DELAY VERNIER control is calibrated to read from zero to 10 divisions. This control functions as a Delay Multiplier when used in conjunction with Sweep B TIME/DIV control

- Accuracy

  Incremental accuracy of the ten-turn calibrated control is within ±0.25%

- Delay Zero Control

  Zero delay is adjustable from a potentiometer located on the side chassis. For extreme accuracy, any or all steps can be adjusted to an external standard

- Delay Range

  Calibrated from a minimum of ¼ microsecond to more than 20 seconds with nominal accuracy of 1%

HORIZONTAL DEFLECTION SYSTEM

- Bandwidth

  Direct Coupled: DC to 3 MHz, down 3 db at 3 MHz

  Capacitively Coupled: Low-frequency cutoff is 80 Hz

- Sensitivity (X10 Expansion)

  EXT/X1 Range : 0.2 volt/div

  EXT/X10 Range: 0.02 volt/div

  X Attenuator : A ten-to-one attenuator is provided in the horizontal deflection channel to extend the input signal range to about 20 volts/div with EXT/10 attenuator

- Input Impedance

  1 megohm shunted by 40 pf (nominal)

Input Connector

X AMP front-panel connector is provided to permit use of the horizontal deflection amplifier for X-Y displays. (Sweep A TRIG connector serves this dual purpose)

X Positioning

A front-panel control permits coarse and fine positioning of the X Input signal or any portion of the sweep to within two divisions of screen center

OTHER CHARACTERISTICS

GATE OUT (Sweep A & B)

Front-panel BSM connectors provide a positive-going pulse of 14 volts nominal. Output impedance is 5000-ohms, and load impedance should be greater than 100K-ohms shunted by less than 15 pf. Gate is referenced directly to ground and is time coincident with each sweep

SAW (Sweep A)

Panel connector provides a positive saw output of approximately 25 volts and is coincident with Sweep A. Output impedance is nominally 10K-ohms, and load impedance should be greater than 100K-ohms shunted by less than 15 pf. Saw output can be used in Single Sweep mode for camera automatic recycling

Y Trace Separation

A front-panel screwdriver adjustment for use in alternate display

Bright Adj

A front-panel screwdriver adjustment for obtaining desired contrast between Sweep A and Sweep B

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SECTION 2
OPERATING INSTRUCTIONS

2-1. FIRST TIME OPERATION (Figures 2-1 to 2-5)

a. Introduction

If this is the first time the Type 74-17A has ever been used, then certain initial adjustments must be made. For instructions, refer to Section 5, Maintenance and Recalibration and to the paragraph indicated, and make the following adjustments.

Adjustment	Paragraph
A&B Sweep Calibration	5-8
A&B Sweep Length	5-9
Strobe Intensity and Pattern Correction	5-13
Delay Zero Adjustment	5-14
Delay Cal Adjustment	5-15

The following illustrations are designed to aid the operator in becoming familiar with the Type 74-17A Dual Time Base Plug-in.

Figure	Description
2-1	Trigger System Panel Facilities
2-2	Function of Controls & Connectors
2-3	Anatomy of Sweep Range Control
2-4	Delay Vernier Control
2-5	Initial Setup

b. Anatomy of Sweep Range Control (Figure 2-3)

Sweep B TIME/DIV switch is provided with an indicator window mounted on a plastic skirt; Sweep A TIME/DIV switch is mounted on top of this skirt and is identified as the Delayed Sweep A knob. Turning the knob of the latter will also permit control of the Delayed Sweep time duration. A push-pull clutch permits the outer knob to engage the skirted knob to adjust both sweep ranges simultaneously, or the Delayed Sweep range knob may be unclutched and rotated independently to sweep rates faster than Sweep B rate.

c. Delay Time Control (Figure 2-4)

When using the Type 74-17A Dual Time Base Plug-in, the start of the horizontal sweep can be delayed for a period of from ¼ microsecond to 20 seconds after application of the triggering waveform. This is accomplished through simultaneous use of Sweep B Time Base and Sweep A Time Base. In this application, Sweep B Time Base is used to provide the accurate time delay while Sweep A Time Base provides a normal horizontal sweep at the end of the delay period. The duration of the sweep delay is controlled by the Sweep B TIME/DIV and the DELAY VERNIER control settings.

d. Initial Setup (Figure 2-5)

Unless otherwise designated, it is presumed that a Y Amplifier Plug-in module is inserted in the Y cavity (left-hand side) and the Type 74-17A Dual Time Base Plug-in unit is inserted in the X cavity (right-hand side) of the Main Frame.

We know that you are anxious to get acquainted with your new instrument. To aid you in this endeavor, you may set up the instrument using the built-in calibrator signal to demonstrate the effects of the various controls on the display. See Figure 2-5 for initial setup of controls. In the instructions which follow, the words in capital letters within the text indicate front-panel controls, connectors, or settings.

2-2. GENERAL OPERATING INFORMATION

a. Introduction

The instructions contained in paragraphs 2-1 and 2-2 constitute a general operating procedure. These procedures, however, do not make full use of the Type 74-17A capabilities. The remaining paragraphs in Section 2 of this Manual are provided to extend the operator's skill in using this instrument.

b. Beam Switching Facilities

The Type 74-17A Dual Time Base Module may be operated as a delaying sweep generator or as two independent time base generators. Electronic beam switching provides alternate presentation of the inputs as indicated by the HORIZONTAL DISPLAY switch settings.

c. Expanded Sweep Operation

Facilities for expanded sweep operation are incorporated in the Type 74-17A to permit a detailed examination of a small segment of the Time Base. Two methods are provided for expanded sweep displays.

In one method, the segment to be expanded is selected by means of a strobe (B INTENSIFIED BY A). The strobe segment is then expanded to occupy the full scale (A DLYD). This method provides a sweep expansion factor that is variable and selectable by the operator.

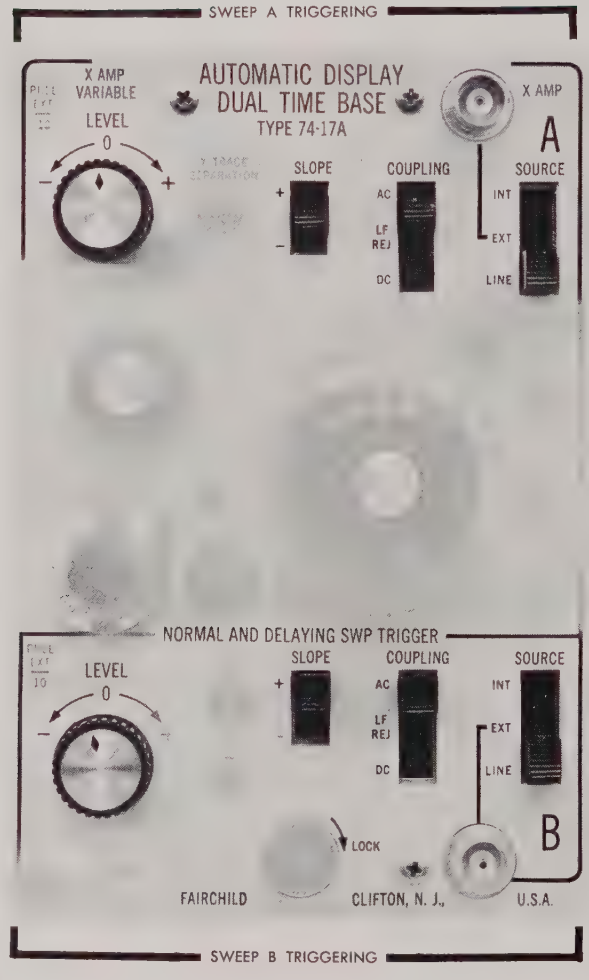
The beam switching facility of the Type 74-17A permits the brightened (strobe) and expanded sectors to be displayed alternately on the CRT screen (ALT). The brightened and expanded sectors can, therefore, be viewed simultaneously.

TRIG A or B SLOPE

2-position slide switch: enables selection of positive going or negative-going signals for triggering the sweep

TRIG LEVEL A or B

Controls: selects trigger signal voltage at which the sweep is fired. A 10 to 1 attenuator is provided on external Trig (PULL EXT/10). Trig A LEVEL serves as X AMP VARIABLE control when HORIZONTAL DISPLAY switch is set up for X amplifier operation



TRIG A or B SOURCE

3-position slide switch: provides selection of INT, EXT and LINE frequency triggering. The EXT setting of TRIG A SOURCE switch is also used for applying X input signals for X-Y plot

TRIG A or B COUPLING

3-position slide switch provides the following selections:

AC: rejects dc and attenuates signals below 80 Hz

LF REJ: rejects dc and attenuates signals below 10 KHz

DC: accepts ac & dc triggering signals

EXT TRIG A or B

BNC connector: for applying triggering signals through EXT position of SOURCE switch. Connector in A triggering section also serves as external X AMP input connector

Figure 2-1. Type 74-17A Front-Panel Facilities, Trigger System

Y TRACE SEPARATION

Screwdriver control: an adjustment for separating the traces when using the automatic dual time base settings of the HORIZONTAL DISPLAY switch

REARM or EXT REARM

Push button switch: permits rearming of SINGLE sweep by manual operation of REARM switch or by remote control operation of EXT REARM connector

SWEEP MODE

Toggle switch: selects NORMAL, AUTO, or HF RECUR triggering for Sweep B only

BRIGHT ADJ

Screwdriver control: an adjustment for obtaining the desired contrast between the intensified position of Sweep A and the normal Sweep B displays

SWP CAL

Screwdriver control: provided to standardize accurately the TIME/DIV switch settings to the main frame

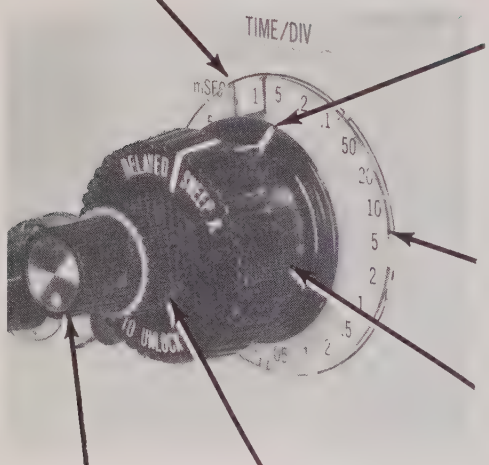
+ SAW

BSM connector: supplies positive saw output and is time coincident with Sweep A

+ GATE A or B

BSM connector: supplies positive going pulse that is referenced directly to ground and is time coincident with each sweep

Figure 2-2. Type 74-17A Function of Controls & Connectors



Notch on transparent skirt indicates SWEEP B rate

Thin white bar on this knob indicates SWEEP A rate

SWEEP B TIME/DIV switch

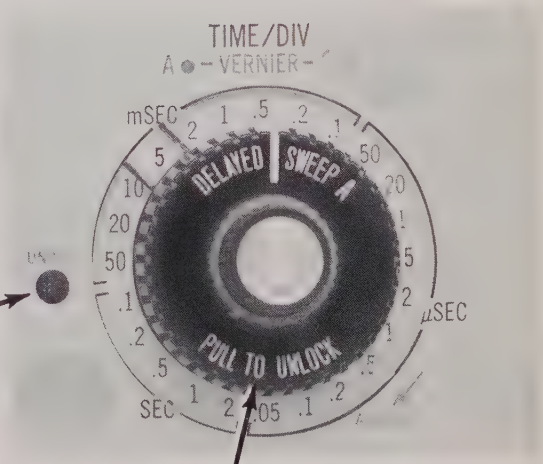
SWEEP A TIME/DIV switch

The push-pull clutch knob (TIME/DIV controls) permits simultaneous or independent control of SWEEP A and SWEEP B rate

VERNIER A control

VERNIER B control

The SWEEP A & B VERNIER controls provide independent and continuous uncalibrated range of sweep rates between ranges (UNCAL lamp lights under these conditions)

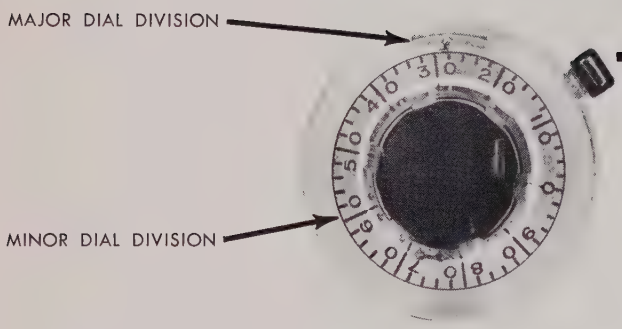


The UNCAL lamp is off when *both* SWEEP A & SWEEP B VERNIER controls are set fully clockwise to CAL

To change the delayed SWEEP A rate only, PULL OUT this knob, then turn to the desired TIME/DIV setting

When the indicators on both knobs are lined up the two knobs lock together and the SWEEP A & SWEEP B rates change simultaneously

Figure 2-3. Anatomy of Sweep Range Control



DELAY TIME CONTROL

A ten-turn precision potentiometer determines the on-screen distance from the Delaying Sweep B start at which the Delayed Sweep A is either triggered or armed

CALIBRATION

The DELAY VERNIER control is calibrated to read from zero to 10 divisions. This control functions as a Delay Multiplier when used in conjunction with Sweep B TIME/DIV control

DELAY MULTIPLIER

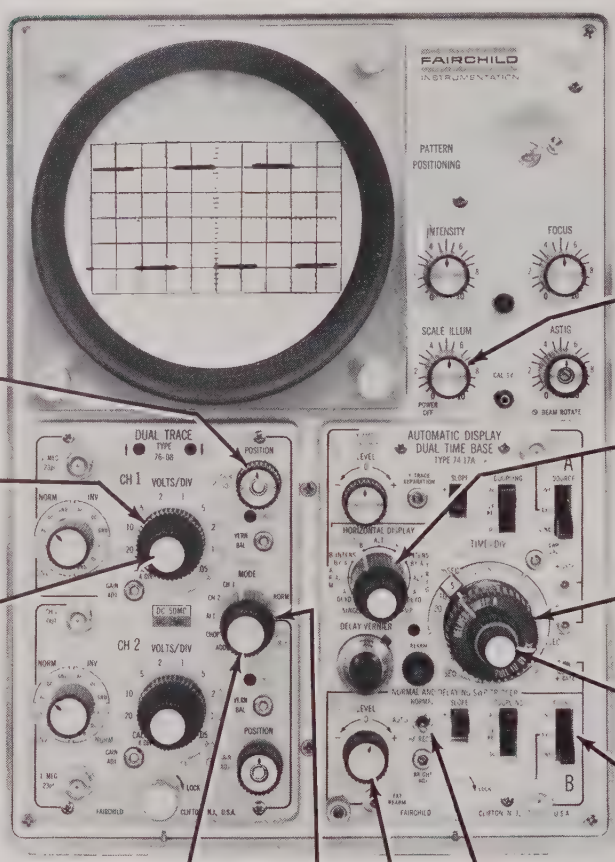
The amount of delay occurring from the application of the triggering signal until the Delayed Sweep A starts, is indicated directly by the setting of Sweep B TIME/DIV switch and DELAY VERNIER dial

For example, assume Sweep B rate is 5 mSEC/DIV, and the DELAY VERNIER dial setting is 3 divisions. The total delay time is computed by multiplying these two settings to yield a calibrated delay time of 15 milliseconds. The above applies only when the Triggered Sweep operational mode is used

Figure 2-4. Delay Vernier Control

To obtain the calibrator display, set the controls exactly as shown and perform the numbered steps in sequence

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls



Readjust INTENSITY, FOCUS & ASTIG controls for a sharp pattern. Readjust POSITION controls to center the display

Set ASTIG, FOCUS, & INTENSITY controls to center of range

1. Rotate clockwise to turn on the oscilloscope

Set to center of range (8)

2. Set outer knob (HORIZONTAL DISPLAY) to Normal Sweep B and rotate inner knob (POSITION) to center of range

Set outer knob (VOLTS/DIV) to CAL (9)

3. Set both TIME/DIV "clutched knobs" to 5 mSEC

Rotate inner knob (VARIABLE) fully clockwise (10)

4. Set both VERNIER controls fully clockwise

5. Set TRIGGERING switches to +, AC, & LINE

Set inner knob (TRIGGER) to NORM (12)

6. Set to AUTO

Set outer knob (MODE) to CH 1 (11)

7. Set to Zero

Figure 2-5. Initial Setup of Type 74-17A Dual Time Base

The second method of expanded sweep operation provides a fixed expansion factor of 10; and the segment of the sweep to be examined is then positioned to the center of the display.

d. Delayed Triggered & Delayed Armed Sweep

To expand a small segment of a displayed waveform to full scale, it is necessary to strobe (brighten or intensify) the segment to be displayed and then expand this segment to full scale. Two methods are provided to obtain this kind of operation. In both cases, a normal time base is produced. However, when the sweep is expanded, the presentation is blanked out until a time interval equal to the time displacement of the intensified segment (strobe) has elapsed. In one method known as DELAYED TRIGGERED operation, the oscilloscope is automatically unblanked, and the expanded sweep is presented at the end of the time delay. In the second method, designated DELAYED ARMED operation, the delayed sweep does not start at the end of the indicated delay period until a pulse is applied to the delayed armed triggering circuit. More about these methods in subsequent paragraphs.

The delayed sweep feature of this instrument may be employed in a number of special applications to increase its versatility. Such applications include high magnification of a selected portion of an undelayed sweep, accurate time measurements, and accurate measurements of waveform jitter. Also, it is possible to pick off and display any desired line of a television scan or to check pulse-time modulation.

2-3. SWEEP TRIGGERING

Two trigger circuits are built into the Type 74-17A Dual Time Base Plug-ins. Each Time Base is provided with its own separate triggering facility.

To obtain a stable display, the sweep must consistently start at the same time relative to recurring cycles of the input waveform. If the sweep is allowed to occur at random or at a rate unrelated to the rate of occurrence of the input waveform, the displayed pattern will be traced out at a different point on the screen each time the sweep runs. This will either cause the waveform to drift across the screen or to be unintelligible. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. For present purposes, the starting of each horizontal waveform across the screen may be called "triggering the sweep." The following instructions tell you how to select and use the proper triggering signal for various applications.

2-4. TRIGGER SOURCE SELECTION

a. Internal

For most applications, the sweep may be triggered by the Y input signal. The only requirement is that the signal amplitude be sufficient to trigger the sweep. To obtain triggering of the sweep from the input signal, set the Trigger SOURCE switch to INT. Internal triggering is convenient since no external triggering connections are required. Satisfactory results are obtained in most applications.

b. External

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within an instrument. With external triggering the triggering signal usually remains constant in amplitude and shape. Thus, it is possible to observe the shaping and amplification of a signal in an external circuit without resetting the oscilloscope triggering controls for each observation. Also, time and phase relationships between the waveforms at different points in the circuit can be seen. For example, if the external triggering signal is derived from the waveform at the input to a circuit, the time relationship and phase of the waveforms at each point in the circuit are compared to the input signal by the displayed waveform.

When a stable, external triggering signal is available it is possible to observe and accurately measure jitter of the displayed waveform with respect to the trigger input signal. This is not possible when the sweep is triggered internally. A trigger preceding the signal may be used to externally trigger the oscilloscope to display the entire signal.

External triggering should also be used with a dual-trace amplifier module in the ALTernate mode to show the proper time relationship between the two displayed signals. To obtain a stable display, the external triggering signal must have an amplitude of at least 0.5 volt, peak-to-peak and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the EXT connector and set the Trigger SOURCE switch to EXT.

c. Line

If the pattern on display bears a fixed time relationship to the power-line frequency, the sweep may be triggered by this signal. To accomplish this, set the Trigger SOURCE switch to LINE.

2-5. TRIGGER COUPLING SELECTION

a. AC Coupling

Selection of the AC triggering mode is accomplished by setting the COUPLING switch to AC. This mode is provided with a high-pass filter that has a low-frequency cutoff nominally at 80 hertzs. This feature prevents erratic triggering when positioning the pattern vertically and using internal triggering. In the

AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display via use of the Trig LEVEL control.

When using the AC mode, the Trigger COUPLING switch is set to AC. The trace always starts at the same point on the *Waveform* for a given Trig LEVEL control setting regardless of the vertical positioning.

Note: AC coupling triggering on the line-frequency calibrator signal or square wave signals less than 100 hzs, may be erratic since the 80-cycle/second cutoff filter severely integrates the trigger. DC coupling is recommended for these signals.

b. DC Coupling

The DC mode is especially useful for viewing waveforms which change very slowly and which are therefore discriminated against by the low-frequency cutoff of the AC position. Because of the coupling network time constant in the AC mode, signals having random repetition rates are sometimes viewed more stably in the DC mode. This mode permits excellent triggering on all types of waveforms and is most useful in the following applications:

1. For optimizing trigger sensitivity or operation when low-frequency signals are applied;
2. For maintaining the initial reference position of the trace with respect to the CRT scale at a given Trigger LEVEL control setting when on Internal source; and
3. For avoiding trigger point variations due to random repetition rate triggering signals.

When using the DC mode, the Trigger COUPLING switch is set to DC. When using internal source, the trace always starts at the same point on the *Scale* for a given setting of the Trigger LEVEL control regardless of the vertical positioning.

c. LF REJ Coupling

The LF REJ mode is a special high-frequency form of the AC mode and is used to reject low-frequency components in the triggering signal. Use AC triggering unless low-frequency rejection is required. Triggering signals with frequency components below 10 KHz may not initiate the sweep circuits when the LF REJ mode is used. The LF REJ mode will provide more stable triggering from a Dual-Trace Plug-in Module when it is set up for alternate sweep mode, and using internal trigger source. The LF REJ mode reduces the effects of a difference in positioning level of the two channels on triggering stability.

Signals must have rise or fall times faster than 100 uSEC when using the LF REJ mode. If slower dual time signals are to be displayed, use external triggering. Note that the Type 76-08 and other multitrace plug-ins are provided with a selector switch which permits triggering from one channel only. With such units, the LF REJ mode might find its greatest use when displaying two non-synchronous signals in the dual alternate mode.

Occasionally it is required to obtain stable triggering from a complex high-frequency waveform that contains undesirable low-frequency noise or line-frequency components. In such cases, the additional noise and line pickup may make it difficult to obtain a stable display. If this occurs, select the LF REJ triggering mode, thereby eliminating the effects of these undesired components. The low-frequency components are blocked from the triggering circuit while the high-frequency triggering waveform is passed to produce the stable triggering that is required. In all other respects, the LF REJ triggering mode is identical to the AC mode.

2-6. TRIGGER SLOPE SELECTION

When the Trigger SLOPE switch is set to +, the sweep is triggered on the rising or positive slope of the excitation signal. When the Trigger SLOPE switch is set to —, the sweep is triggered on the falling or negative slope of the excitation signal.

2-7. TRIGGER LEVEL SELECTION

The Trig LEVEL control permits selection of a specific voltage which the triggering signal must exceed before the sweep fires. When the Trigger SLOPE switch is set to the + position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently on the positive slope of the excitation signal. Conversely, with the Trigger SLOPE switch set to the — position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently on the negative slope of the excitation signal.

2-8. SWEEP MODE SELECTION (Sweep B Only)

a. Introduction

A front panel toggle switch selects either NORMAL, AUTO or HF RECUR triggering for SWEEP B only.

b. Normal or Triggered Sweep

When the front panel toggle switch is set to NORMAL, Sweep B is set up for triggered sweep. In this mode, the sweep circuit is normally at rest. An input signal triggers Sweep B circuit and the sweep starts. Concurrently, the circuit locks out all triggering signals until one sweep cycle has been completed. In this mode, the sweep start is always locked to the start of the vertical input signal, even if the frequency of the input signal changes.

A stable pattern for practically all types of signals can be obtained by using triggered sweep. Its use is mandatory for viewing random or non-periodic sig-

nals having low repetition rates. Use of the triggered sweep mode of operation in the majority of applications is the preferred condition under which optimum triggering performance can be expected of this instrument. For triggered sweep operation, proceed as follows:

1. Apply the desired signal to the Y Input connector and set the toggle switch to NORMAL.
2. Adjust Trigger LEVEL control to initiate the sweep and the POSITION controls to center the display.
3. Adjust Y VARIABLE control in conjunction with Y VOLTS/DIV switch to obtain a vertical deflection of approximately 4 divisions.
4. Adjust Sweep B VERNIER and TIME/DIV controls to obtain the desired display. Readjust the Trigger LEVEL control if necessary.
5. Adjust INTENSITY and FOCUS controls to obtain a sharp trace of suitable brightness.
6. If there is any multiple triggering of the sweep, the Trigger LEVEL control may be adjusted to select the signal levels which will best actuate the trigger circuit. Thus, undesirable signals of lesser amplitude will be rejected by the trigger channel.
7. Set Trigger COUPLING switch to LF REJ to obtain a more stable display when using high-frequency triggering signals. Use DC coupling when the triggering waveform is very slow.

c. Automatic Sweep Operation

When using the AUTO mode, a horizontal reference trace will appear on the screen even in the absence of an input signal. This AUTOmatic mode is very useful while testing equipment since a reference trace will always be visible regardless of whether a signal is applied to the oscilloscope or not.

The sweep free runs until a trigger signal with frequencies between about 20 Hz and approximately 10 MHz is applied. Application of a trigger signal switches the sweep to the triggered mode immediately, locking in on the input signal.

d. HF Recur Operation

Setting the front-panel toggle switch to HF RECUR produces a free-running sweep independent of any triggering signal. The frequency of the recurrent sweep is dependent upon the setting of Sweep B TIME/DIV control. When using the HF RECUR mode, the reference trace becomes more visible at higher sweep rates.

The HF RECUR mode is provided to permit improved synchronization of high-frequency input signals in the range from 5 MHz to above 50 MHz. Sweep B rep rate must be the same as, or a sub-multiple of vertical input signal for proper performance.

2-9. HORIZONTAL DISPLAY SELECTION

a. Normal Sweep Displays (Figure 2-6)

The normal or conventional sweep display sector of the HORIZONTAL DISPLAY switch consists of the following three settings:

HORIZONTAL DISPLAY (Normal Sector)

Setting	*Function*
B	Sweep B only
A	Sweep A only
ALT	Sweep A & B displayed alternately

In this mode, the Type 74-17A may be operated as two independent time base generators. Beam switching provides alternate presentation of a single signal at two different sweep rates. If a dual trace plug-in is used, Channel 1 input is locked to Sweep A, Channel 2 to Sweep B.

b. Triggered Sweep Displays (Figure 2-7)

The triggered sweep display sector of the HORIZONTAL DISPLAY switch consists of the following three settings.

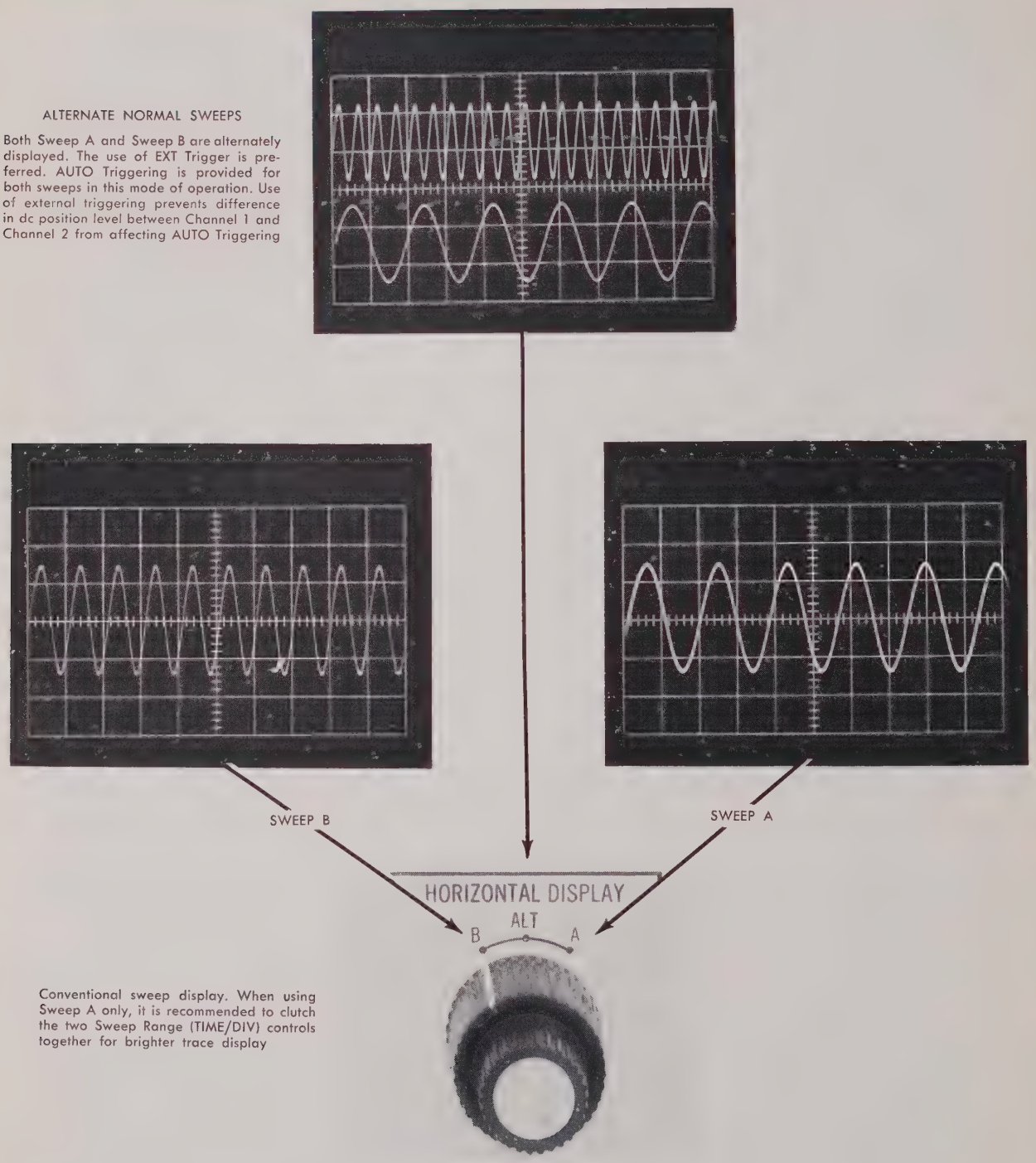
HORIZONTAL DISPLAY (TRIG Sector)

Setting	*Function*
B INTENS BY A	Delayed Sweep A is displayed as a brightened segment (strobe) superimposed on Sweep B
A DLYD	Strobed segment is expanded to full scale and automatically displayed
ALT	The above two functions are displayed alternately on screen. In other words, the ALT position displays a waveform which indicates a section to be expanded, and at the same time, displaying the fully expanded section without the need for manual switching

When the HORIZONTAL DISPLAY switch is set to B INTENS BY A (TRIG) and the Sweep A TIME/DIV switch is set for a higher sweep rate than Sweep B TIME/DIV switch, a portion of the sweep may be brightened. (See Figure 2-7.) The start of the brightened portion (Strobe) indicates the start of the delayed Sweep A and the length of the strobe

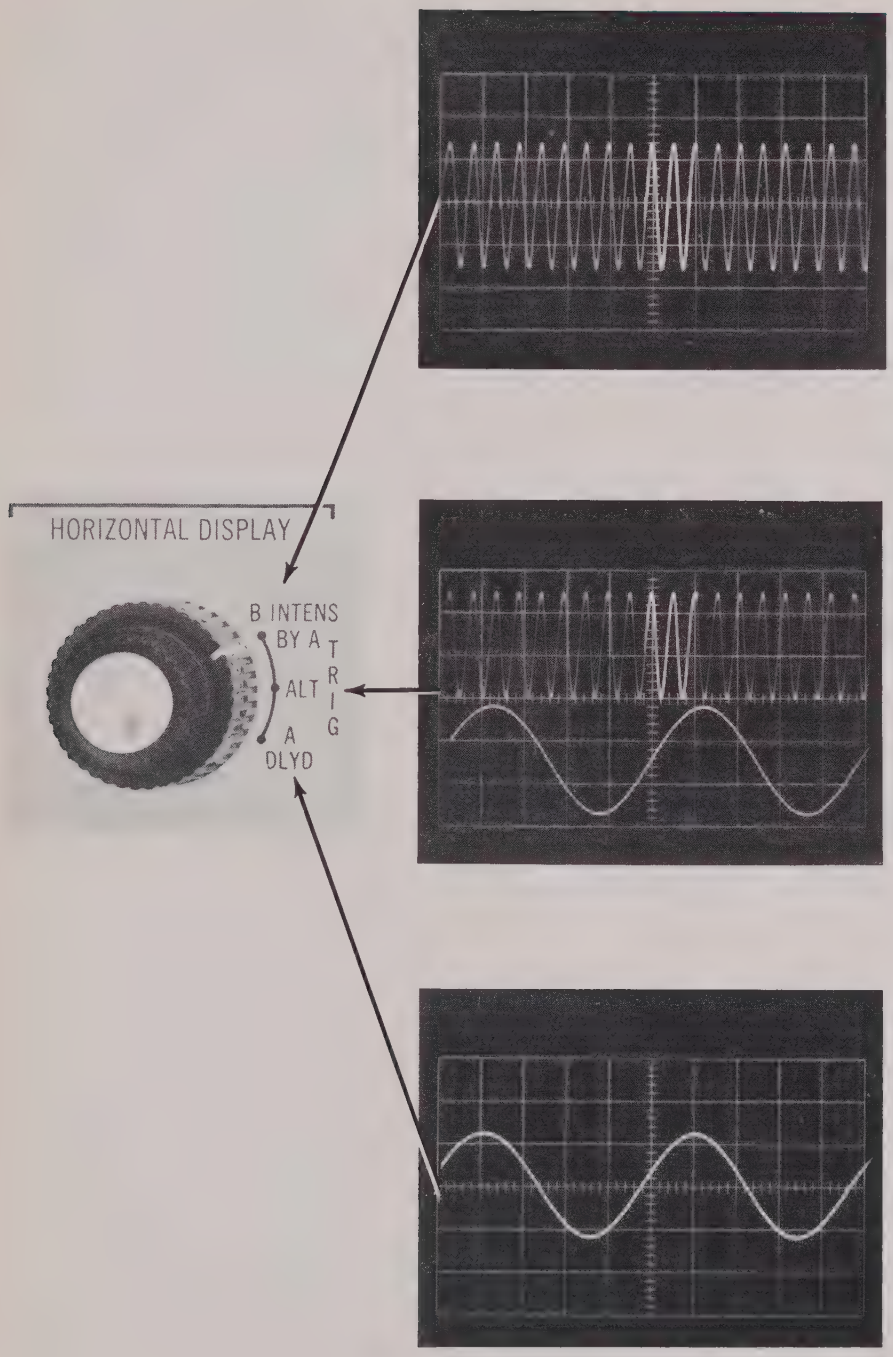
ALTERNATE NORMAL SWEEPS

Both Sweep A and Sweep B are alternately displayed. The use of EXT Trigger is preferred. AUTO Triggering is provided for both sweeps in this mode of operation. Use of external triggering prevents difference in dc position level between Channel 1 and Channel 2 from affecting AUTO Triggering



Conventional sweep display. When using Sweep A only, it is recommended to clutch the two Sweep Range (TIME/DIV) controls together for brighter trace display

Figure 2-6. Normal Sweep Displays



SWEEP B INTENSIFIED BY SWEEP A (TRIGGERED MODE)

Sweep B display showing Sweep A as a brightened sector of Sweep B. Sweep A (strobe) starts immediately after the delay pick-off trigger is generated

ALTERNATE TRIGGERED DISPLAY

The two triggered modes of operation are displayed alternately on screen. The brightened and expanded sectors can, therefore, be viewed at the same time

SWEEP A DELAYED BY SWEEP B (TRIGGERED MODE)

The brightened sector of Sweep B is displayed expanded to full scale

Figure 2-7. Triggered Sweep Displays

indicates the Delayed Sweep A duration. The start of the strobe may be positioned left or right with the DELAY VERNIER control. The length of the strobe may be adjusted with the Sweep A TIME/DIV control. Note that the start of the strobe is not affected by the setting of the latter control. Using these two controls, it is possible to include any portion of the display waveform in the brightened or strobed area.

NOTE: The electronic switch may not function properly in the fast sweep ranges for a very small delay. (DELAY VERNIER control near zero setting, hence the strobe is not turned on.)

The amount of delay occurring from the application of the triggering waveform until the Sweep A is permitted to run, is determined by the setting of the Sweep B TIME/DIV switch and the DELAY VERNIER control. The Delayed Sweep A will occur immediately at the end of the preset delay period. This mode from now on will be referred to as the Delayed-Triggered sweep mode. It is the mode of operation that permits the operator to select continuously variable delay times for making accurate time and waveform jitter measurements.

When the HORIZONTAL DISPLAY switch is set to A DLYD the brightened section of the display in the B INTENS BY A position is now expanded to full scale. See Figure 2-7.

The delayed sweep feature of the Type 74-17A may be used to provide higher apparent sweep expansion than is provided by the PULL X10 switch.

Sweep A rate is not actually increased; the apparent horizontal expansion is the result of delaying Sweep A presentation (predetermined by Sweep B TIME/DIV switch and DELAY VERNIER control settings) before it is displayed on screen.

The apparent sweep expansion may be computed by dividing Sweep B TIME/DIV setting by Sweep A TIME/DIV setting. This ratio may be expressed:

$$\text{Expansion ratio} = \frac{\text{Sweep B TIME/DIV setting}}{\text{Sweep A TIME/DIV setting}}$$

For example, if Sweep B TIME/DIV switch is set to 10 mSEC, and Sweep A TIME/DIV switch is set to 0.1 mSEC, the brightened portion of the sweep is expanded horizontally 100 times when the HORIZONTAL DISPLAY switch is set to the Triggered A DLYD position.

c. Armed Sweep Displays (Figure 2-8)

The armed sweep display sector of the HORIZONTAL DISPLAY switch consists of the following three settings.

HORIZONTAL DISPLAY (ARMed Sector)

Setting	*Function*
B INTENS BY A	Delayed Armed Sweep A is displayed as a brightened segment superimposed on Sweep B
A DLYD	Brightened segment is expanded to full scale and is displayed upon actuation of Sweep A circuit by a trigger
ALT	The above two functions are displayed alternately on the screen

When the HORIZONTAL DISPLAY switch is set for Delayed-Armed operation, the delayed sweep does not start at the end of the indicated delayed period until a triggering pulse is applied to Sweep A trigger circuit. This triggering pulse may be either the input waveform to the oscilloscope or an externally-derived triggering signal. The triggering SOURCE, COUPLING, SLOPE, and LEVEL may be selected in the same manner as for the Delayed Triggered operation. In the Delayed-Armed mode of operation, the Delayed Sweep does not start precisely at the delay time indicated by the DELAY VERNIER and Sweep B TIME/DIV control setting, but instead is initiated by the next suitable triggering following the indicated delay interval. See Figure 2-8.

The armed delayed time display does not appear to be continuously variable. The Armed mode should be used whenever the signal to be displayed has accumulative jitter between the start of the normal sweep and the delayed expanded section.

d. Single Sweep Setup (Figure 2-9)

Single-sweep operation infers that the time base moves but one stroke until reset. Using a repetitive sweep to view a varying waveform would result in an overlapped and unintelligible display caused by many displays being superimposed on one another. However, when it is desired to view a single display of an input signal which continually varies in amplitude, shape, or time, the instrument may be set up for single-sweep presentation. Thus, by commanding but one stroke of the sweep at a time, single sweep operation eliminates the overlapping caused by the multiple traces and enables the display to be viewed and/or recorded clearly. Reset may be accomplished manually or through external contact closures.

To arm the sweep manually, set the HORIZONTAL DISPLAY switch to SINGLE and depress the REARM button. The Delayed Sweep A will remain armed until a trigger signal arrives to fire the sweep. One sweep will occur after which further incoming

triggers are locked out until the circuit is rearmed. In other words, a single trace will sweep across the screen each time the sweep is triggered and at the end of its travel, the beam will rest off screen. The REARM indicator should now be off thus indicating that the sweep requires rearming (resetting).

To rearm the sweep, push in the REARM button. The REARM lamp will go on, indicating the sweep is armed and ready to fire on the next trigger. Refer to Figure 2-9.

e. X Amplifier Displays (Figure 2-10)

The X Amplifier sector of the HORIZONTAL DISPLAY switch consists of the following two settings.

HORIZONTAL DISPLAY (X Ampl Sector)

Setting	*Function*
X AMP	The internal time base is disconnected and the plug-in is set up for application of external signals for horizontal deflection
B with X	The automatic beam switching feature provides normal Sweep B displays and X-Y plots to be displayed alternately on the screen

CAUTION

KEEP INTENSITY LOW

Screen damage can result from too intense a beam resting at one point on the screen.

X-Y displays may be used to show sweep signal generator plots, Lissajous phase measurements, curve trace information, and other similar signal relationships.

When desiring to view one voltage plotted against another (not the internal time base) apply the Y signal to the input connector on the Y Plug-in and the X signal to X Amp (green) BNC connector on the Type 74-17A. Set the HORIZONTAL DISPLAY switch to X Amp, Trigger A SOURCE switch to EXT and SLOPE switch to +. Adjust the VOLTS/DIV controls on the Y Plug-in and the X AMP VARIABLE (green) control on the X Plug-in to obtain an appropriate display.

Note: When the Type 74-17A Automatic Display Dual Time Base is set up for X amplifier operation, the Trig A LEVEL control (black label) now functions as the X AMP VARIABLE gain control (green label).

2-10. X10 SWEEP EXPANSION DISPLAY (Figure 2-11)

When the POSITION control knob is pulled out, any portion of the trace may be expanded horizontally by a factor of 10 about the screen center. This feature extends the fastest sweep rate to 5 nanoseconds/division. Thus, to achieve a 10X expansion of a desired segment of a trace, set that segment to the screen center by the POSITION control and then pull out this control. Any portion of the expanded display may be observed by adjusting the POSITION control.

When the instrument is set up for calibrated X10 expansion of the sweep, the sweep rate indicated by the setting of the TIME/DIV control must be divided by 10 to obtain the actual time required for the spot to move one division. For example, if the TIME/DIV control is set to 10 mSEC, the actual time per division is 10 milliseconds, divided by 10, or 1 millisecond per division.

2-11. GATE OUTPUT (Sweep A & B)

A positive gate coincident with the sweep output is available on a front-panel BSM connector labeled + GATE. The gate amplitude is 14 volts nominal into an impedance of 5000 ohms and load impedance should be greater than 100K ohms shunted by less than 15 pf. This positive pulse may be used to trigger other devices in order to achieve sufficient delay to view the output of such devices completely displayed on the oscilloscope.

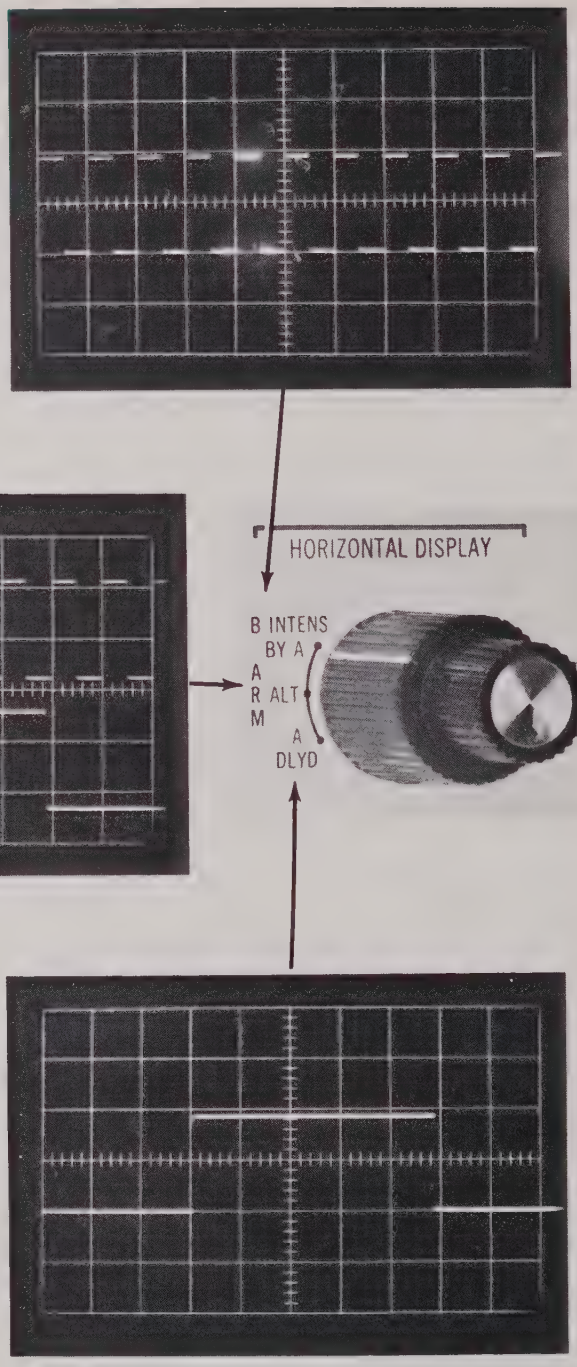
Use of the gate output in conjunction with triggered pulse generators will permit the instrument to display the leading edge of the pulse waveform even though no signal delay is incorporated in the Y Amplifier.

The period of the positive gate may of course, be measured extremely accurately with an electronic counter. Since the period of the gate output is a direct measure of total sweep time, it is possible to use this oscilloscope in conjunction with a counter to digitize the time duration of input signals. Use of the TIME/DIV and the VARIABLE controls will permit the operator to display the waveform to be measured over the entire sweep. Timing accuracies of 1 part in 10 are thus readily obtainable.

2-12. SAW OUTPUT (Sweep A only)

A front-panel BSM connector labeled + SAW provides a positive-going saw of approximately 25 volts amplitude and is coincident with Sweep A.

The sawtooth voltage may be used for initiating delayed activities controlling a X-Y plotter, or acting as a time base for associated analog equipment. The saw output should not be loaded by an impedance to ground of less than 100K ohms shunted by no more than 15 pf. Saw output can be used in Single Sweep mode for camera automatic recycling.



SWEEP B INTENSIFIED BY SWEEP A
(ARMED MODE)

Sweep B display showing Sweep A as a brightened sector. Sweep A (strobe) is armed by the delayed trigger and initiated by a sync trigger

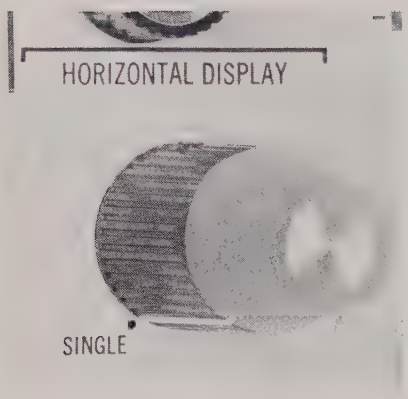
ALTERNATE ARMED DISPLAY

The two armed modes of operation are displayed alternately on screen. The brightened and expanded sectors can, therefore, be viewed simultaneously

SWEEP A DELAYED BY SWEEP B
(ARMED MODE)

The brightened sector of the Sweep B is displayed expanded to full scale

Figure 2-8. Armed Sweep Displays



Set HORIZONTAL DISPLAY switch to SINGLE

SINGLE SWEEP

MODE

The single sweep mode permits but one driven sweep of Sweep A to appear on the screen until the sweep is reset or rearmed

REARMING

The single sweep may be REARMED manually by a front-panel pushbutton switch or remotely through the EXT REARM connector

REARM LAMP

The Single Sweep REARM indicator is lit whenever the Sweep A gate multivibrator is rearmed and ready to be triggered. This lamp is located inside the REARM pushbutton

RATE

The single sweep rate is shown by the Sweep A TIME/DIV setting and sweep may be triggered with or without delay

WITH DELAY

Apply the triggering signal to Sweep B input. The delay will be the DELAY VERNIER setting multiplied by the Sweep B TIME/DIV setting

WITHOUT DELAY

Apply the triggering signal directly to Sweep A input

Figure 2-9. Single Sweep Setup

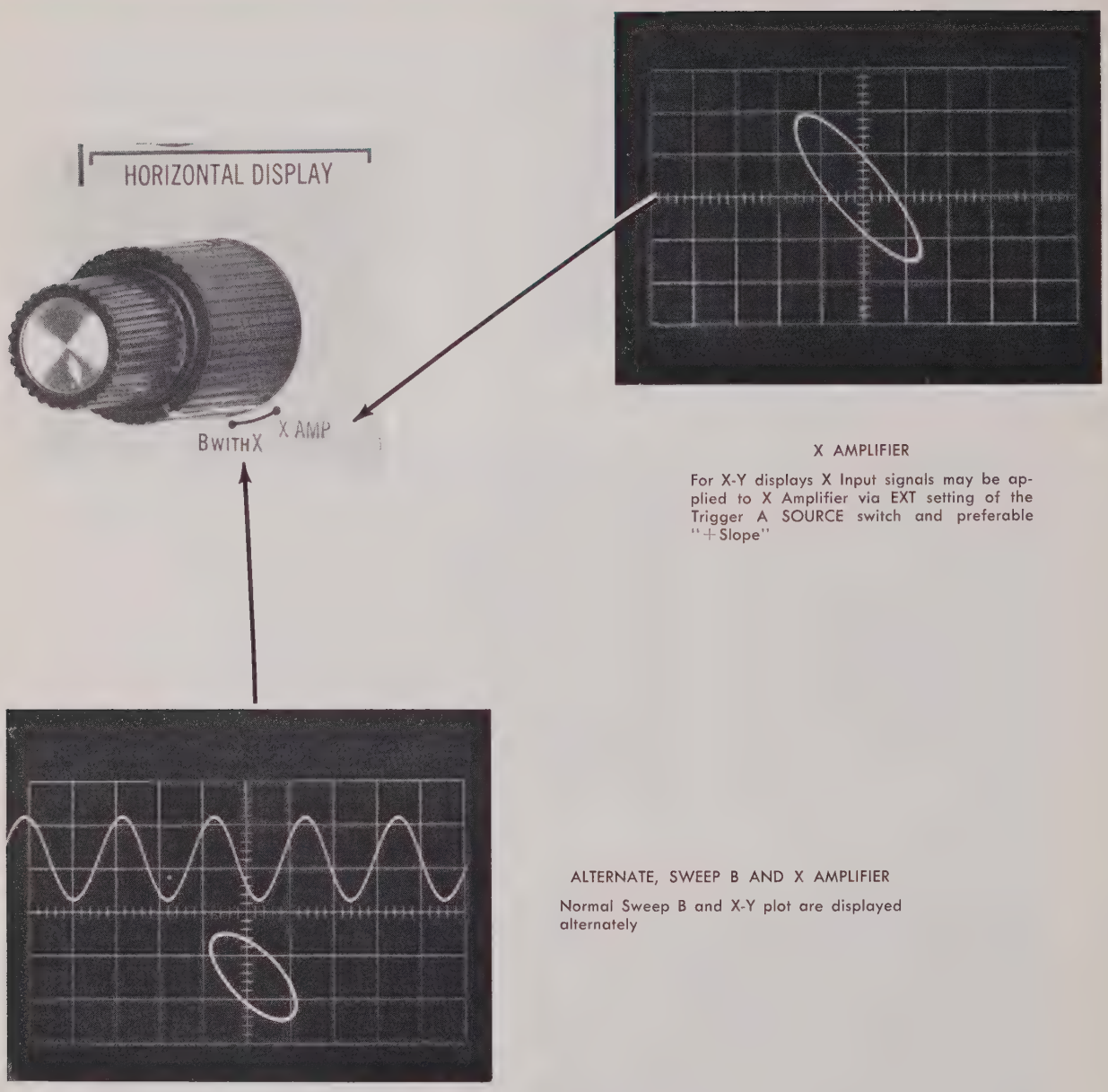
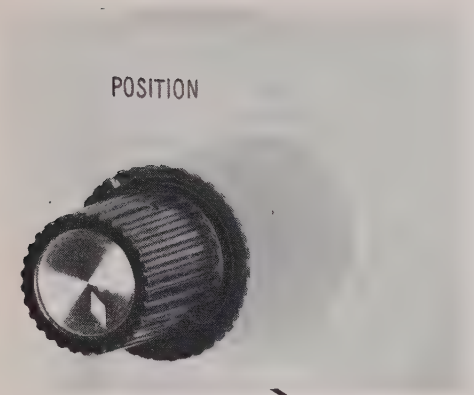
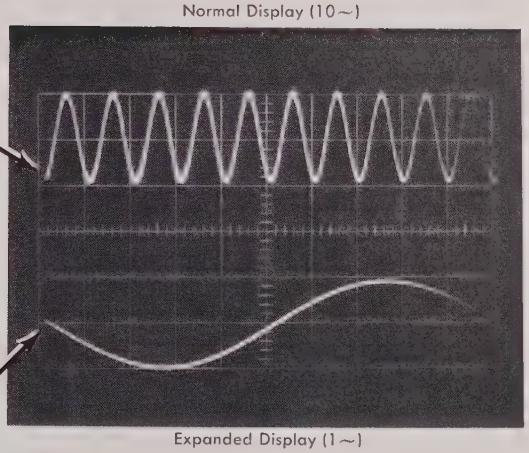

HORIZONTAL DISPLAY
B WITH X
X AMP
X AMPLIFIER
For X-Y displays X Input signals may be applied to X Amplifier via EXT setting of the Trigger A SOURCE switch and preferable "+ Slope"
ALTERNATE, SWEEP B AND X AMPLIFIER
Normal Sweep B and X-Y plot are displayed alternately

Figure 2-10. X Amplifier Displays



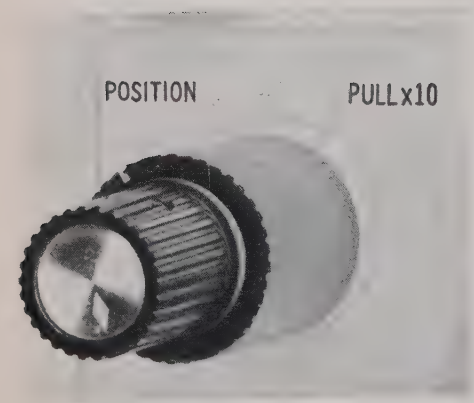
Push in for
Normal Display

Normal Display (10~)



Expanded Display (1~)

Pull out for
Expanded
Display



To achieve a X10 expansion of a desired segment of the trace;

1. Set that trace segment of interest to the screen center with the POSITION control
2. Pull out the POSITION control (PULL X10)
3. Divide the TIME/DIV setting by 10 to obtain the actual time required for the spot to move one division

Figure 2-11. X10 Sweep Expansion Display

2-13. SWEEP CALIBRATION ADJUSTMENT

Whenever the Time Base Plug-in is removed from the Main Frame and inserted in another, the front-panel screwdriver SWP CAL control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities. To properly normalize the plug-in unit to the Main Frame, proceed as follows:

1. Set up the instrument for normal display of the CAL signal. Allow a warmup time of 15 minutes. (See Figure 2-5.)
2. Set TIME/DIV switch to 10 mSEC.
3. Adjust SWP CAL front-panel screwdriver control for precisely 6 cycles of the calibrator display (60-cycle line) in 10 divisions.

Note: For 50-cycle line, adjust SWP CAL control for 5 cycles of the calibrator display; for 400-cycle line, use 0.5 mSEC/DIV sweep and adjust SWP CAL control for 2 cycles of the calibrator display.

2-14. TIME MEASUREMENTS

a. Elapsed Time Measurements (Figure 2-12)

Any horizontal distance on the screen of the oscilloscope can be used to represent a precise interval of time when the time-base circuits are set up for calibrated sweep (TIME/DIV VERNIER control set to CAL). Use of this feature permits you to accurately measure the elapsed time between the desired point of interest on the display. To measure the time interval, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in divisions between that portion of the display whose time interval you wish to find.
2. Multiply the horizontal dimension obtained in Step 1 by the TIME/DIV control setting to obtain the time interval. See Figure 2-12.

b. How to Find Repetition Rate of Frequency (Figure 2-13)

The repetition rate or frequency for periodic signals can be expressed as the number of cycles or pulses per unit of time (TIME/DIV VERNIER control set to CAL). To use the oscilloscope for measuring the repetition rate or frequency of periodic signals proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in divisions occupied by one cycle of the display under observation.
2. Multiply the horizontal dimension obtained in Step 1 by the TIME/DIV control setting.
3. Take the reciprocal of the product obtained in Step 2 (that is, divide it into one). The resulting quotient is the desired frequency or repetition rate in cycles per second. See Figure 2-13.

$$\text{Cycles/second} = \frac{1}{\text{Time (seconds)}}$$

2-15. PHASE-SHIFT MEASUREMENTS (Figure 2-14)

To measure the phase difference between two sine waves, proceed as follows:

1. Set up the Type 74-17A Dual Time Base for externally triggered Normal Sweep B operation.
2. Apply one of the sine waves to Channel 1 Input and the other to Channel 2 Input of a Dual Trace Amplifier Plug-in.
3. Set MODE switch on the Y Dual Trace Module to ALT.
4. Adjust the Sweep B TIME/DIV switch for a couple of cycles of the display on the screen.
5. Position the display so that one of the positive slopes crosses the horizontal center line at the left hand side of the scale.

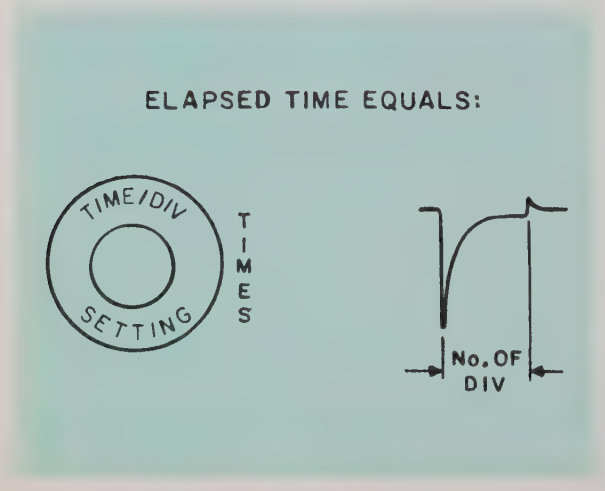


Figure 2-12. Elapsed Time Measurement

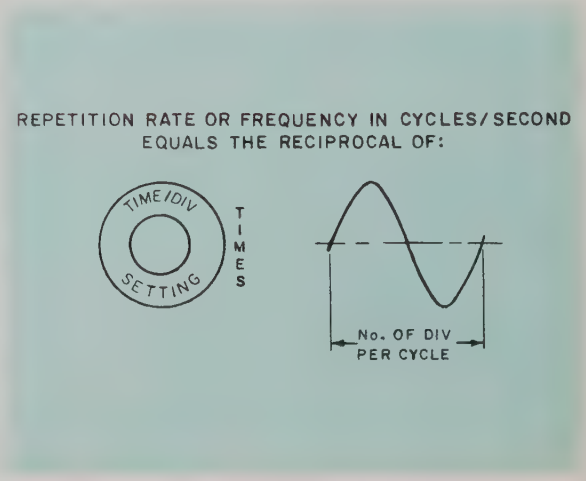


Figure 2-13. Finding the Frequency

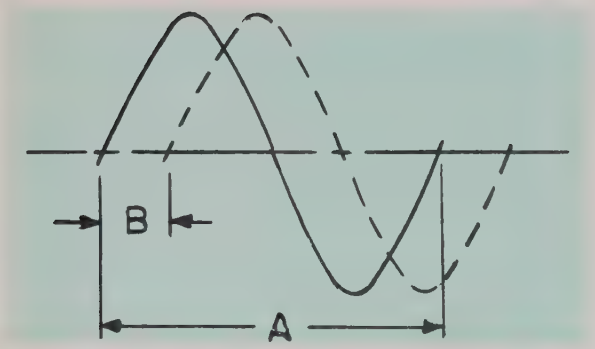


Figure 2-14: Phase-Shift Measurements

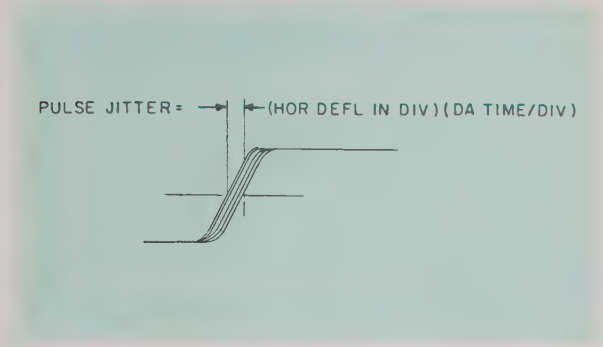


Figure 2-16. Pulse Jitter Measurement

6. Measure the horizontal distance occupied by one cycle of the waveform. Label this distance A.

7. Measure the horizontal shift of the Channel 2 displiay. Label this distance B.

8. Divide the distance measured in step 6 by the distance measured in step 7 and multiply the quotient by 360°. The resulting product is the phase difference between the two sine waves. See Figure 2-14.

$$\text{Phase-shift difference} = \phi = \frac{B}{A} 360°$$

2-16. PULSE WIDTH MEASUREMENTS USING THE DELAY VERNIER CONTROL

The following technique avoids human error (parallax interpolation of graticule lines) and should be used with more than routine accuracy if needed:

1. Make sure Sweep B TIME/DIV VERNIER control is set fully clockwise to CAL (click is heard).

2. Set HORIZONTAL DISPLAY switch to TRIG B INTENS BY A and adjust the controls for several cycles of the signal.

3. Pull out Sweep A TIME/DIV knob and turn it to the right until the intensified area is a small bright dot.

4. To measure pulse width, turn the DELAY VERNIER control until the bright spot is at the 50% part of the leading edge of the desired pulse (Figure 2-15a). Record the dial reading.

5. Turn the DELAY VERNIER control to move the bright dot to the 50% point on the trailing edge of the same pulse (Figure 2-15b). Record the dial reading.

6. Subtract the reading of step 4 from that of step 5. Then multiply the difference by the setting of Sweep B TIME/DIV switch. The product is the pulse width.

2-17. PULSE JITTER MEASUREMENTS (Figure 2-16)

Pulse jitter may be defined as small incremental variations in pulse spacing in a pulse train. For example, assume a normal pulse train is displayed on the screen and it is desired to check a small pulse in the train for jitter; to check, proceed as follows:

1. Set up the instrument for external triggering.

2. Set the HORIZONTAL DISPLAY switch to TRIG B INTENS BY A.

3. Pull out Sweep A TIME/DIV knob and turn it to the right until the intensified zone (strobe) of the display is about the same width as the pulse to be checked.

4. Adjust the DELAY VERNIER dial to move the strobed sector over the pulse.

5. Set the HORIZONTAL DISPLAY switch to TRIG A DLYD and adjust the DELAY VERNIER control to position the strobed pulse to screen center.

6. The leading edge of the strobed pulse will then show jitter if present. The amount of jitter can be measured in time by multiplying the horizontal distance in divisions of the jitter area by the setting of Sweep A TIME/DIV knob. See Figure 2-16.

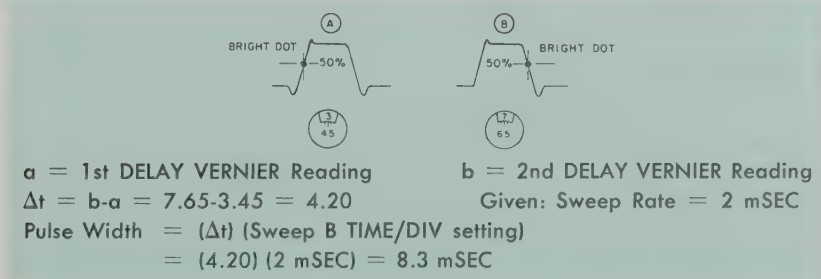


Figure 2-15. Pulse Width Measurements Using Delay Vernier Dial

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION (Figures 3-1 to 3-7)

To simplify circuit description, functional block diagrams are provided as follows:

Figure	Description
3-1	Sweep B Trigger Circuit
3-2	Sweep A Trigger & X Input Circuits
3-3	Normal Sweep B
3-4	Triggered Strobe Mode
3-5	Delayed Triggered Mode
3-6	Armed Strobe Mode
3-7	Horizontal Deflection Amplifier

The circuit description will be keyed to the aforementioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be referred to in following the circuit description.

3-2. TRIGGER CIRCUIT DESCRIPTION (Figures 3-1 and 3-2)

a. Sweep B Triggering Circuit

Since the input of Sweep B Triggering Circuit is similar to that of Sweep A Triggering Circuit, only Sweep B Triggering Circuit will be discussed in detail. Refer to paragraph 3-8 for a description of the X Input Circuit.

The input cathode follower, V810 provides high impedance for signals applied to the EXT connector. This stage also isolates the input and preceding circuits from Sweep B Trigger circuit.

The input to the trigger amplifier V8101 and V8102 may be selected from one of three sources via the Trigger SOURCE switch as follows:

1. In EXT or EXT/10 position, the signal is obtained from an external source through the EXT front-panel connector;

2. In INT position, the signal is derived from the Y Plug-In unit; and

3. In LINE position, the signal is tapped from one side of the 6.3 VAC heater circuit.

A choice of AC, LF REJ, or DC coupling is provided by the Trigger COUPLING switch. In the AC position, the trigger signal is applied to a high-pass filter consisting of C8103, C8104, and R8114, providing a low-frequency cutoff of 80 cps. The low-frequency cutoff is raised to 10 Khz in the LF REJ position and the high-pass filter now has R8109 shunting R8111. In the DC position, the high-pass filters are disconnected and the triggering signal is applied directly to the trigger amplifier. The RC network, R8112 and C8106, in series with the grid of V810, serves to protect the input circuit from damage due to excessive input voltage. Shunt capacitor C8106 across R8112 preserves the high-frequency signal component.

The negative pulse at the output of the trigger amplifier occurs only when there is a positive-going signal at the input. However, it is desirable to start the sweep during either a positive-going or negative-going portion of the excitation signal. To accomplish this, the Trigger SLOPE switch is used to select the desired polarity of the triggering signal.

For positive-going signals, connection is made to the base of Q8101, and for negative-going signals, connection is made to the base of Q8102. In each case, the opposite base is connected to a dc bias source, adjustable by means of the Trig LEVEL control R8106. This control is used to select the level of the triggering point for all settings of the Trigger SLOPE switch.

The output from Q8101 or Q8102 is applied to a trigger shaper Q8103 which drives the trigger coupling transformer T8101. The resulting negative trigger is applied to series coupling diode CR8201 to the base of the delaying sweep gate multivibrator Q8201. The TRIG SENS B adjustment R8126, sets the tunnel diode trigger at its optimum sensitivity.

b. Automatic Triggering

When the Sweep B Mode Toggle switch is set to AUTO, the automatic trigger circuit, Q8104 to Q8106 is activated. Application of a trigger signal from 20 cps to 10 Mc/s switches the sweep immediately from the free-running mode to the triggered mode. This technique insures stable synchronization of the desired input signal. The auto trigger multivibrator Q8104 and Q8105 reverts to its natural mode in about 50 ms after the discontinuance of the trigger excitation signal. Consequently, a horizontal reference trace will appear on the screen even in the absence of an input signal.

3-3. CIRCUIT DESCRIPTION OF NORMAL SWEEP B (Figure 3-3)

a. Sweep B Multivibrator

The input triggering signal is applied to the base of transistor Q8201, through series-coupling diode CR8201. The dc coupled bistable multivibrator Q8201 and Q8202, initiates the formation of the sweep after receiving a negative trigger from the shaper circuit. Diode CR8201 and the lockout circuit hold off sub-

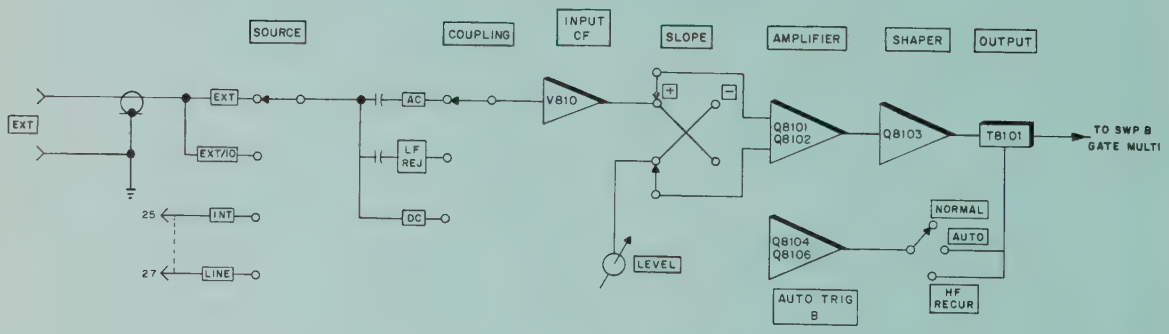


Figure 3-1. Sweep B Trigger Circuit, Functional Block Diagram

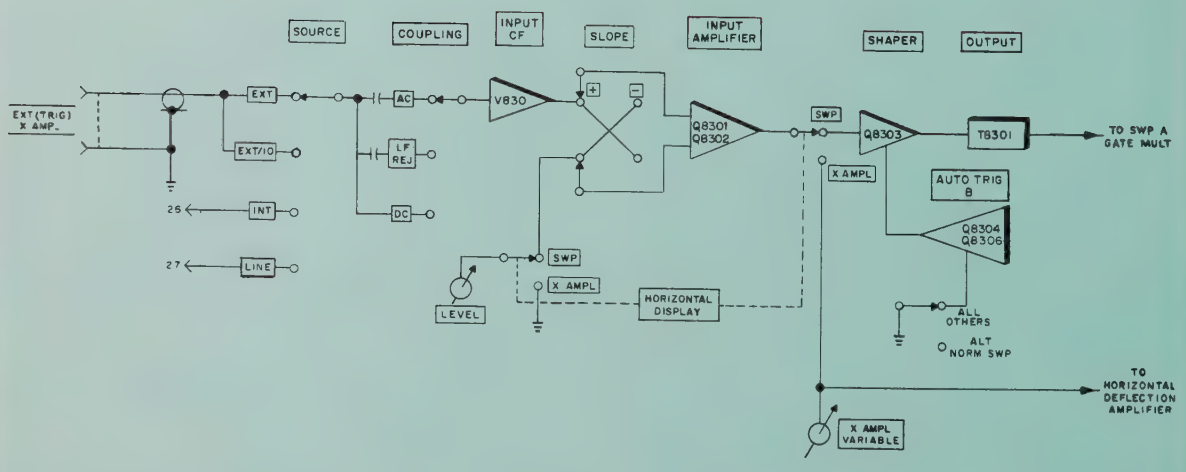


Figure 3-2. Sweep A Trigger & X Input Circuits, Functional Block Diagram

sequent triggering signals until after the sweep and retrace are completed. In the quiescent state, Q8201 is conducting and Q8202 is at cutoff. Q8201 forms a positive gate while Q8202 forms a negative gate during the forward sweep interval.

CR8201 serves as a low capacitance coupling diode which couples the negative trigger from the shaper circuit to the sweep B multivibrator which flips and initiates the sweep. CR8201 also serves as a high back-impedance diode to decouple the trigger shaper from the sweep B multivibrator. After the bistable multivibrator has been triggered, the sweep runs up. When the saw reaches full screen deflection, turn-off diode CR8202 conducts and resets the multivibrator Q8101 and Q8202, which then clamps the saw. The SWP LENGTH potentiometer R8229 is adjusted for full screen sweep length display.

b. Saw Generation

The saw generator is of the Miller "run-up" type. The negative output developed at the collector of Q8202 is applied to the anodes of the disconnect diodes CR8214, CR8215, CR8216, CR8217 and CR8218, causing these diodes to no longer conduct. This action unlocks the integrator clamp and permits the selected sweep capacitor to charge linearty through Q8207, CR8219, the associated resistance network and Q8603 and Q8602. These latter transistors are emitter followers and their voltage outputs are adjustable via manipulation of the SWP CAL control.

The timing capacitor is connected to a cathode follower V820. A cathode follower is employed here to provide high impedance for the sweep timing RC network. High impedance coupling for this network prevents extraneous current drain, thus permitting a highly linear charging voltage to be developed when large charging resistors are used.

When the grid side of the timing capacitor starts to move in the negative direction, the cathode of V820 tends to move likewise. This produces a negative swing at the base of Q8206 and a positive swing at its collector. The positive voltage is coupled through emitter follower Q8207 and zener diode CR8219, and is applied to the opposite side of the timing capacitor. Zener diode CR8219 maintains a fixed voltage difference between the collector of Q8206 and the grid of V820 to assure minimum voltage at the collector.

The positive voltage swing on the opposite side of the timing capacitor tends to prevent the grid side from swinging negatively. It also increases the voltage to which the timing capacitor is trying to charge. The net result is to *straighten out* the charging curve (sweep voltage) by maintaining a constant current flow in the capacitor.

Since the grid of V820 remains at a constant potential within a small fraction of a volt, the current through the charging resistor remains constant and the sweep timing capacitor thus charges at a constant rate. The resulting linear sawtooth waveform is applied to the horizontal deflection system.

c. Sweep Length

The sweep length, or the total duration of the sweep for any given sweep rate is determined by the setting of the Sweep LENGTH adjustment R8229. A portion of the positive sawtooth voltage is fed back to the turn-off emitter follower Q8203, and the saw turn-off diode CR8202.

If the Sweep Length potentiometer is properly set, diode CR8202 will conduct when the positive-going excursion of the sawtooth has travelled 10.5 to 11 divisions on the screen. This positive peak signal will then be conducted through diode CR8202 to the base of Q8201. Upon receiving this positive signal, the sweep gate multivibrator will revert rapidly to its original state with Q8201 conducting, and Q8202 at cutoff. The positive step from the collector of Q8202 returns the disconnect diodes CR8214, CR8215, CR8216, CR8217 & CR8218 to their conducting state, thus discharging the timing capacitors. The Miller circuit now returns to its quiescent level and is ready for the next sweep cycle after the lockout time interval is completed.

d. Lockout Circuit

The lockout circuit prevents the sweep gate multivibrator from being triggered until the sweep retrace interval has reverted the saw to its quiescent base level. The sweep does not retrace in zero time since the clamping of the Miller integrator timing capacitor is accomplished by a diode switch circuit having a small impedance. The timing circuit discharge (saw retrace) takes longer than the flipping of the sweep gate multivibrator. Consequently, the trigger excitation pulses must be held off to prevent the formation of a new saw during the retrace interval. The sawtooth waveform must be permitted to retrace completely to its quiescent base which re-establishes the beam at the left-hand side of the CRT screen. This is accomplished by holding the cathode of the series-triggering diode CR8201 at a suitable positive voltage for a given period after the completion of the sweep.

During the forward sweep interval, a portion of the positive sweep voltage is fed back to the base of the turn-off emitter follower Q8203, which charges the lockout capacitor through coupling diode CR8205. When the saw reaches its predetermined full screen length, the sweep gate multivibrator flips and clamps the Miller integrator which then causes the sweep to retrace. During the return-trace interval, diode CR8205 is cut off and the lockout capacitor is discharged through R8208. The sweep gate multivibrator will not retrigger until the preselected lock-

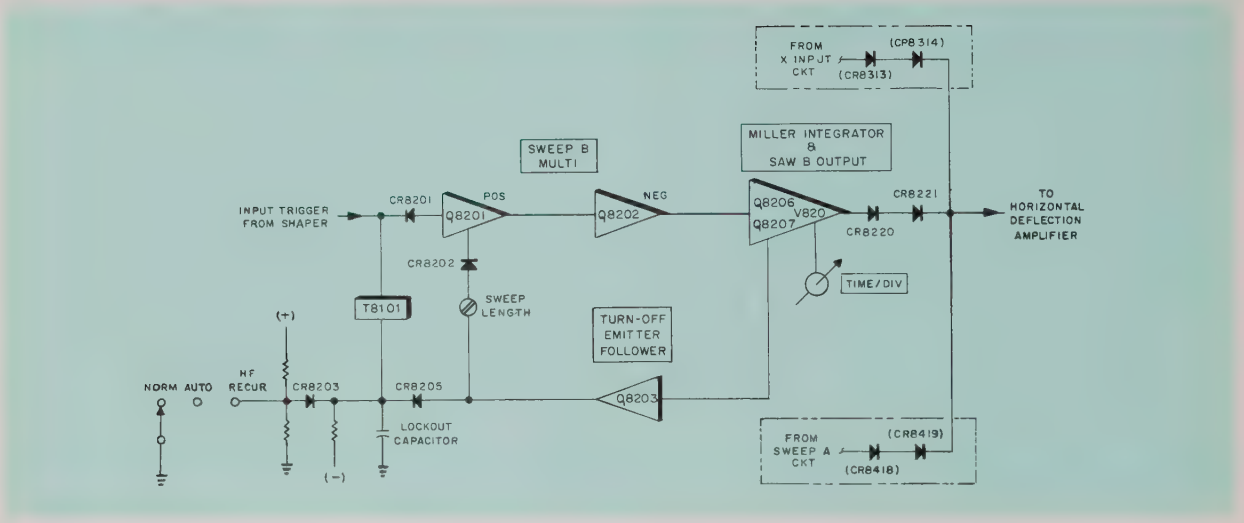


Figure 3-3. Normal Sweep B, Functional Block Diagram

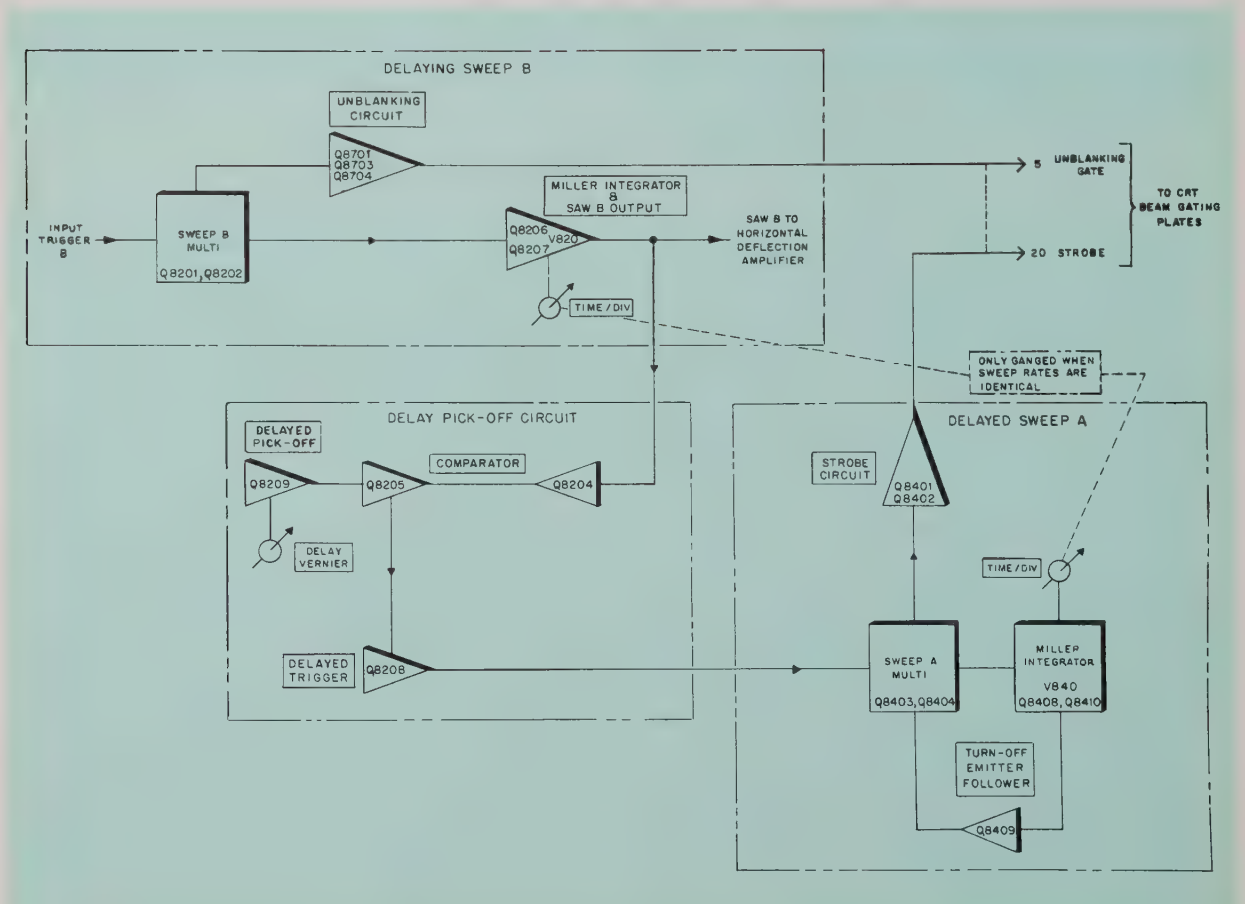


Figure 3-4. Triggered Strobe Mode, Functional Block Diagram

out timing capacitor, chosen to give lockout beyond the time required for the sweep to return to its initial starting point, has completely discharged.

The duration of the lockout interval is related to the sweep-charging time constant and the Miller integrator clamp. Consequently, the TIME/DIV switch must also change the lockout circuit hold-off timing capacity. This technique prevents additional triggers from initiating the sweep gate multivibrator until the sweep retrace interval is completed and the saw reverts to its quiescent state at the left-hand side of the screen.

The trigger coupling diode CR8201 prevents triggers from disturbing the sweep gate multivibrator during all of the sweep-forward interval. The lockout circuitry prevents retriggering during the retrace interval.

e. HF Recurrent Sweep

When the Sweep B Mode Toggle switch is set to HF RECUR, a positive voltage is applied to the base of transistor Q8106. The resulting negative voltage at the collector of Q8106 back-biases diode CR8203, thus cutting it off. This permits the cathode of the trigger coupling diode CR8201 to fall far enough to trigger Sweep B multivibrator Q8201 and Q8202, and thus initiate a sweep. When the sweep reaches its predetermined turn-off level, Sweep B multi is reset through diode CR8202 and the sweep retraces. The sweep retrace starts the lockout period whose duration is determined by the discharge of the lockout capacitor through R8208. When the lockout voltage at the cathode of CR8201 falls far enough again, the cycle is repeated. The result is a free-running sweep whose period is the total of the sweep time plus the lockout time at any given setting of Sweep B TIME/DIV switch.

f. Unblanking

The cathode-ray tube employed in this oscilloscope has two additional beam deflecting plates which cut off the electron beam independently of the control grid. Beam control pulses (trace brightening and retrace blanking pulses) can easily be dc coupled since these beam deflection plates are electrically close to ground. In conventional circuits these pulses must be coupled to the control grid which is operated at high potential. The extra beam deflection plates are controlled by the sweep gate multivibrator Q8201 and Q8202.

The positive pulse developed at the collector of Q8201 of Sweep B gate multivibrator is applied to the base of the unblanking cascode amplifier Q8703 and Q8701. This gate signal is coincident with Sweep B forward time and is also available at a front-panel connector labeled + GATE. The resulting negative pulse developed at the collector of Q8701 is applied to the beam deflection plate of the cathode-ray tube through emitter follower Q8704. Therefore the display is visible only during the forward sweep interval and is blanked during the retrace and lockout interval.

Zener diode CR8701, serves as a voltage source for the collector of Q8701, and it also prevents the collector voltage from exceeding 125 volts.

A portion of the negative pulse from the unblanking emitter follower Q8704 is applied to a differentiating network C8721 and R8727. The output from this network provides the proper trigger to the blanking multivibrator of the Dual Trace Plug-in.

These Delaying Sweep Time Base Plug-in units may be used in the X or Y cavity of the Main Frame. Only the X cavity permits retrace beam blanking signals to be coupled to the cathode-ray tube. Therefore, sweep operation in the vertical direction will show the sweep retrace.

3-4. CIRCUIT DESCRIPTION OF TRIGGERED-STROBE MODE (Figure 3-4)

When the HORIZONTAL DISPLAY switch is set to B INTENS BY A (TRIG), the delay pick-off, the delayed sweep, and strobe circuits are activated.

In the "triggered" mode, Delaying Sweep B receives the external trigger signal while Delayed Sweep A receives its trigger signal later from Sweep B. The triggering signal for the delayed sweep in this mode is derived from the delaying sweep at the exact instant this sweep reaches a level determined by the adjustment of the delay pick-off circuit. This mode from now on will be referred to as the delayed-triggered mode.

The Normal and Delaying Sweep circuit functions as previously described. Major differences between the triggered strobe and the Normal mode circuits may be seen by comparison of the block diagram.

Referring to Figure 3-4, the saw from the Delaying Sweep B circuit is applied to the horizontal deflection amplifier and to the input of the delay pick-off comparator circuit Q8204 and Q8205.

This circuit is a differential amplifier which compares the voltage level of the input delaying sweep against a fixed voltage obtained from the DELAY VERNIER control. When the voltage level of the delaying sawtooth waveform reaches a certain level, as determined by the setting of the DELAY VERNIER control, the output of the comparator circuit is applied to a delayed trigger amplifier Q8208, which drives coupling transformer T8201. The negative pulse from the secondary of this transformer is through series-coupling diode CR8412, to trigger the delayed Sweep A multivibrator Q8403 and Q8404.

The positive gate developed at the collector of Q8403 is coincident with the Sweep A TIME/DIV control setting and is applied to the strobe circuit

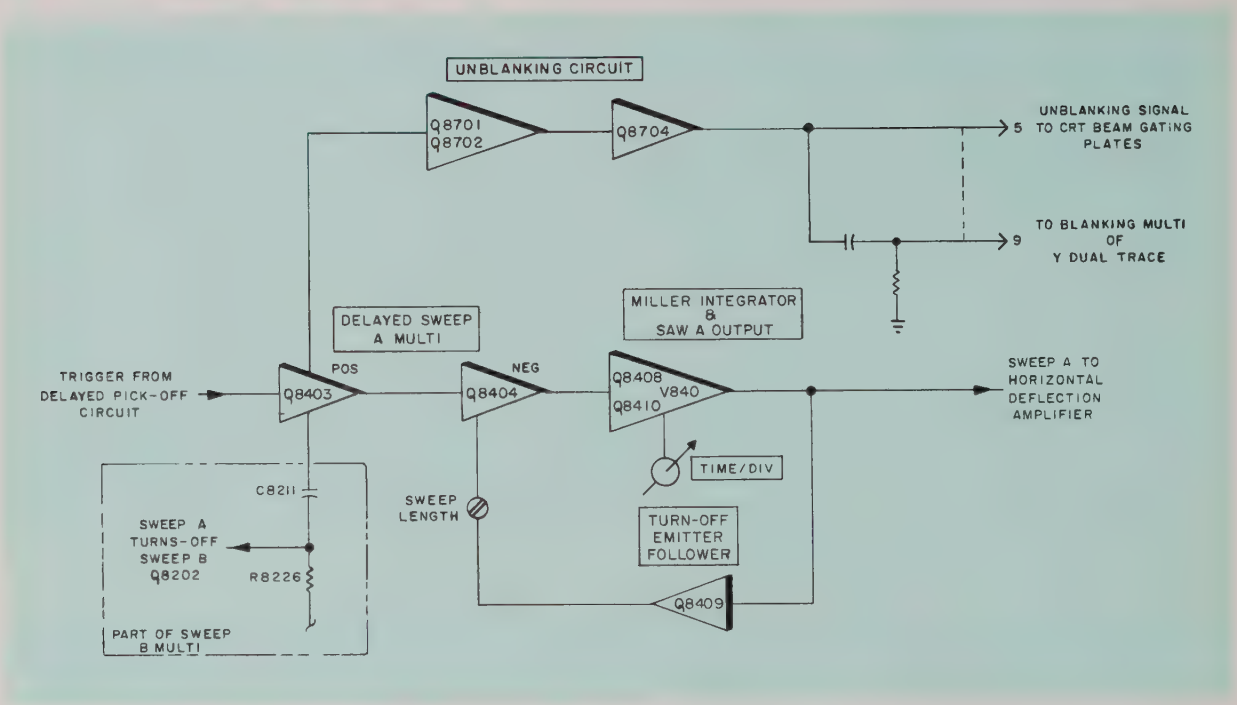


Figure 3-5. Delayed-Triggered Mode, Functional Block Diagram

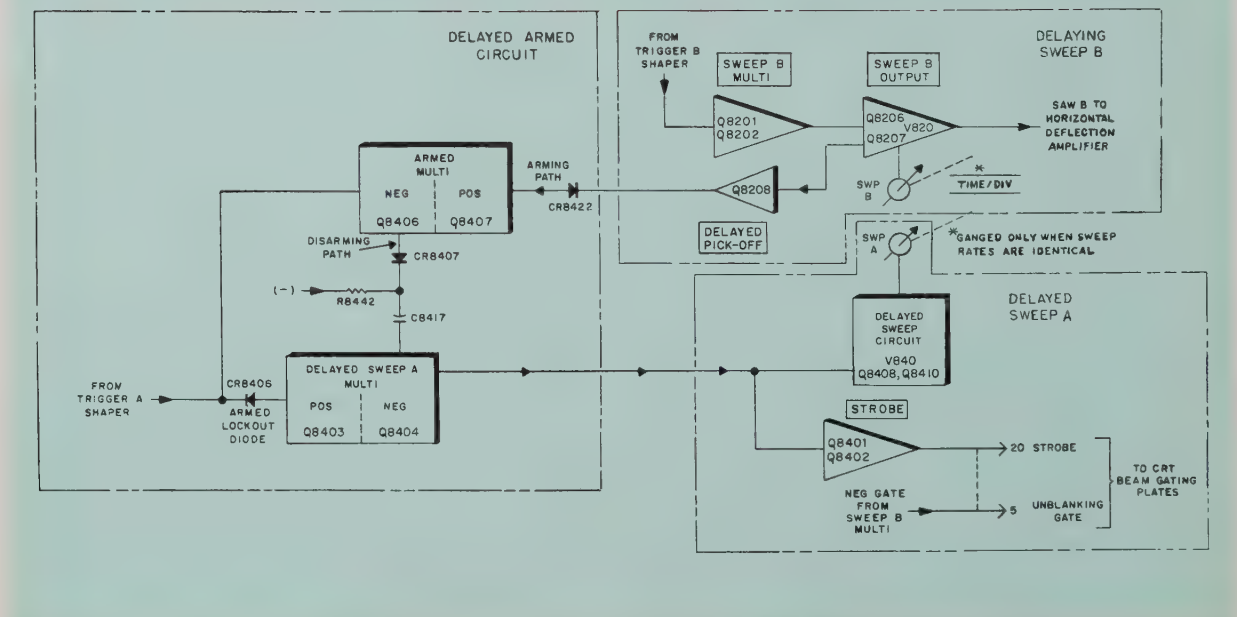


Figure 3-6. Armed Strobe Mode, Functional Block Diagram

Q8401 and Q8402. The positive strobe signal is applied to one of the beam-gating electrodes of the CRT. The delaying Sweep B unblanking gate is applied to the other beam-gating electrode.

The cathode-ray beam is kept turned off in the absence of a sweep signal. When a sweep is in progress, the beam is turned on by an unblanking signal that lasts as long as the sweep and then turns the beam back off after the sweep is completed. When both the delaying and delayed sweeps are running, each produces its own unblanking signal. The delayed Sweep A unblanking pulse (strobe) makes a brighter trace than the delaying Sweep B pulse.

The difference in brightness for the two pulses is useful for finding out where to set the delay controls to display the part of the signal you wish to examine. Detailed instructions on setting up the strobe is found in Section 2, Operating Instructions.

The delaying sweep is automatically turned off when the delayed sweep has terminated. This action is developed as follows: the positive gate produced at the collector of the delayed Sweep A multivibrator Q8403, is applied to a differentiating network consisting of C8211 and R8226. Series-coupling diode CR8206, is biased to permit only the trailing edge of the delayed Sweep A gate to trigger the delaying Sweep B multivibrator and subsequently terminating Sweep B.

3-5. CIRCUIT DESCRIPTION OF DELAYED-TRIGGERED MODE (Figure 3-5)

When the HORIZONTAL DISPLAY switch is set to A DLYD (TRIG) the delayed Sweep A and not the delaying Sweep B is applied to the horizontal deflection amplifier. The brightened sector of the display in the B INTENS BY A position will now be expanded to full screen in the DLYD position.

The delayed-triggered sweep circuit is similar in operation to the triggered-strobe mode described earlier, except that the strobe circuit is now deactivated.

The delayed sweep is automatically turned off when the delaying sweep has terminated. This action is developed as follows: The positive gate produced at the collector of the delaying Sweep B multivibrator (Q8201), is applied to a differentiating network consisting of (C8411 & R8433). Series coupling diode (CR8404) is biased to permit only the trailing edge of the delaying Sweep B gate to trigger the delayed Sweep A multivibrator and subsequently terminating Sweep A.

Automatic provision is made for shut-off of the delaying sweep when the delayed sweep terminates. This technique permits maximum duty cycle performance in the Delayed Mode.

MODE (Figure 3-6)

When the HORIZONTAL DISPLAY switch is set to ARMED B INTENS BY A position, the delay pick-off circuit, the arming multivibrator, the delayed sweep, and strobe circuits are activated.

In the "armed" mode, the delayed Sweep A is triggered by a selected external triggering signal. All triggering signals are blocked by the armed lockout diode until a signal from the delay pick-off circuit triggers the arming multivibrator. This action unlocks the diode and opens the trigger circuit to the delayed sweep, making it possible for the next appropriate triggering signal to initiate the delayed sweep. In this mode of operation, the delayed sweep does not start precisely at the delay time indicated by the DELAY VERNIER and Sweep B TIME/DIV control settings, but instead is initiated by the next suitable triggering following the indicated delay interval. This mode from now on will be referred to as the Delayed-Armed mode of sweep operation.

The armed lockout diode CR8406, is now forward-biased by the voltage applied to it from the collector of Q8406, thus opening the triggering circuit to Sweep A multivibrator Q8403 and Q8404.

The REARM lamp on the front-panel goes on when the delay time has elapsed and indicates that the delayed sweep circuit is ready to be triggered. When the delayed sweep is triggered, the REARM lamp then goes out. If the delayed-armed sweep is triggered immediately at the completion of the delay time, the REARM lamp may not appear to go on.

The next suitable trigger from the Trigger A circuit is applied to the Delayed Sweep A multivibrator which immediately changes its state (it flips). Q8403 forms a positive gate while Q8404 forms a negative gate during the "delayed" sweep forward interval.

In the quiescent state of the armed multivibrator, Q8406 is at cutoff and Q8407 is conducting. The armed lockout diode CR8406 is back-biased by the voltage applied to it from the collector of Q8406. This action locks out incoming triggering signals to the delayed sweep A multivibrator, thereby inactivating the delayed sweep.

The arming signal from the delayed pick-off circuit is coupled from transformer T8201, through diode CR8422, to the base of transistor Q8407. The bistable armed multivibrator changes its state: Q8407 is at cutoff and Q8406 is conducting.

The leading edge of the negative gate at the collector of Q8404 is differentiated by C8417 and R8442 and applied to the base of transistor Q8406 through diode CR8407. This disarming trigger reverts the armed multivibrator to its initial condition.

After the bistable delayed sweep A multivibrator has been triggered, it will revert to its original state as determined by the setting of the SWP LENGTH

HORIZONTAL DISPLAY CHART

Position	*Setting*	*Function*
1*	A DLYD	Delayed Armed Sweep
2	ALT (ARMED)	Alternate, Armed Delayed and Strobed Sweep
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
5	ALT	Alternate, Sweep A and Sweep B
6	A	Sweep A
7	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate, Triggered Delayed and Strobed Sweep
9	A DLYD	Delayed Triggered Sweep
10	X AMP	X Amplifier
11	B WITH X	Alternate, Sweep B and X Amplifier
12	SINGLE	Single Sweep

* fully ccw

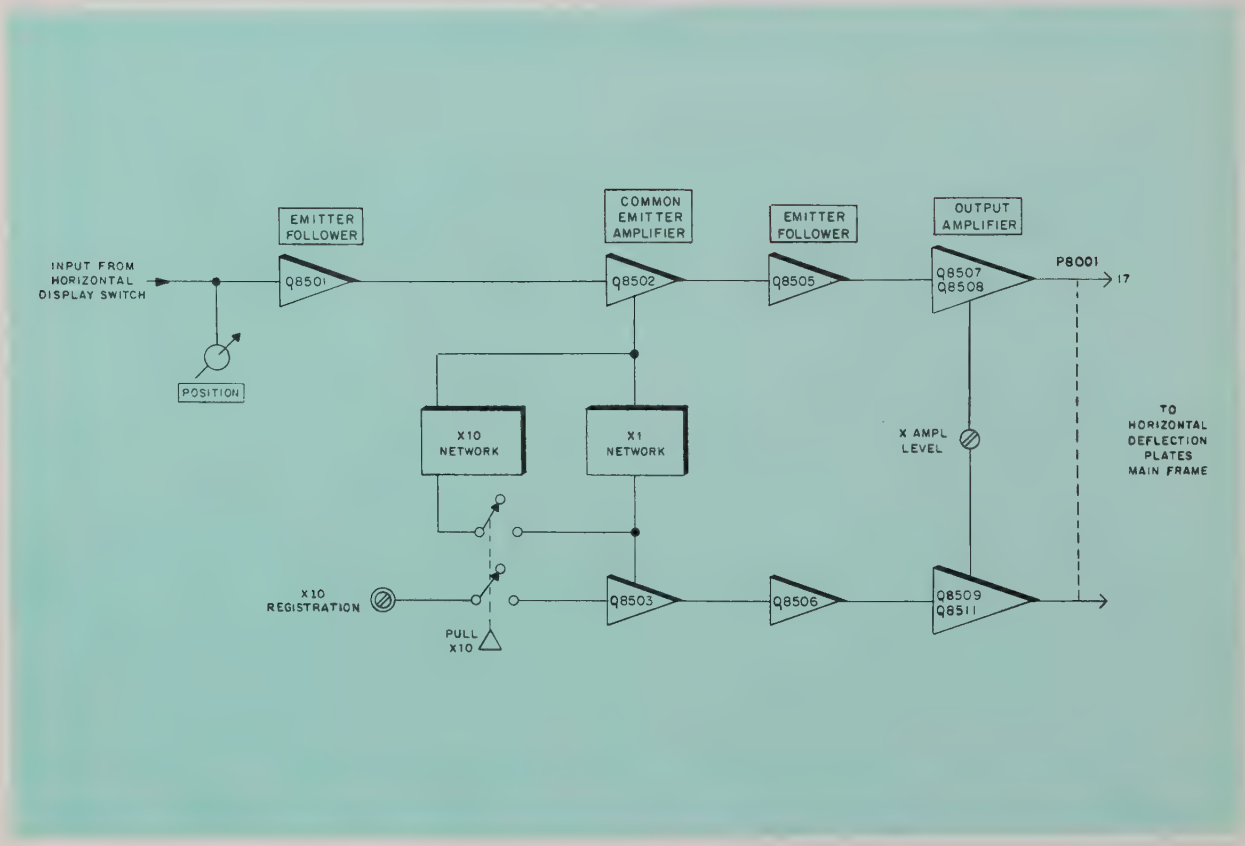


Figure 3-7. Horizontal Deflection Amplifier, Functional Block Diagram

adjustment R8474. The delayed sweep A will remain inactivated until the armed multivibrator is rearmed by a signal from the delayed pick-off circuit.

The development of the strobe and unblanking pulses are identical to that described for the triggered-delayed mode. Automatic provision is made for turning off Sweep B when Sweep A has terminated. This prevents brightening of the sweep retrace in the strobe position.

3-7. CIRCUIT DESCRIPTION OF DELAYED-ARMED MODE

When the HORIZONTAL DISPLAY switch is set to the ARMed DLYD position, the delayed sweep is applied to horizontal deflection plates.

The delayed-armed sweep circuit is similar in operation to the armed-strobe mode described earlier, except that the strobe circuit is now inactivated.

3-8. HORIZONTAL DEFLECTION CIRCUIT DESCRIPTION (Figure 3-7)

When the HORIZONTAL DISPLAY switch is set to X AMP, the EXT TRIG A input connector becomes the X Amplifier input. Simultaneously, the Sweep A LEVEL control becomes the X AMPlifier VARIABLE control. The PULL EXT/10 setting provides 10:1 attenuation of the X Input signal. Thus external signals may be applied to the X AMP front-panel BNC connector. These signals are coupled to the X Input amplifier V8301 and V8302. The output of this amplifier is coupled to the horizontal deflection circuit via the X AMP setting of the HORIZONTAL DISPLAY switch.

The output from V8102 is applied through a voltage divider network to the base of emitter follower Q8501 via the HORIZONTAL DISPLAY switch.

The POSITION control supplies a manually-adjustable dc voltage to the base of Q8501 for positioning the display on the screen. For the Type 766H Series, a PATTERN POSITIONING control is mounted on the front-panel of the Main Frame, and it is electrically coupled to the POSITION control of both the X and Y Plug-ins. This feature permits positioning the entire display in the horizontal and vertical directions on the screen via use of the single joystick control.

The output from the emitter of Q8501 is applied directly to the common emitter amplifier Q8502 and Q8503, which converts the single-end input to a push-pull output. The signal progresses through emitter follower Q8505 and Q8506, and is then applied to the output amplifier Q8507 to Q8511. In this output amplifier stage, the signal develops the necessary power for driving the horizontal deflection plates.

Ten-times magnification of the sweep is accomplished by reducing the common emitter amplifier feedback of Q8502 and Q8503, by a factor of 10 when the X10 control is pulled out. Consequently, the sweep rate observed on the screen of the cathode-ray tube is effectively magnified ten times. The X10 REGISTRATION potentiometer R8512 is provided to adjust the voltage level at the base of Q8503 so that the center of the trace is not depositioned from CRT screen center when the PULL X10 switch is activated.

3-9. MASTER TIMING CIRCUITRY

The master timing circuit consists of an electronic switch, alternate sweep lockout and trace blanking circuits.

When the HORIZONTAL DISPLAY switch is set to one of the ALTernate modes, the alternate-sweep switching circuit accomplishes the following functions.

1. Gates the sweep signals from the time base generators into the horizontal deflection amplifier and thus determines whether Sweep A or Sweep B is to be displayed.
2. Provides the Y Plug-in Amplifier with dual-trace slaving pulses.
3. Applies trace-separation voltage to the vertical deflection amplifier when Sweep B is displayed.
4. Disables Sweep B unblanking circuit during presentation of the delayed Sweep A.

When alternate A and B sweeps are to be displayed, the horizontal deflection amplifier and the cathode-ray tube must be time-shared between the two displays. Alternate sweep lockouts and blanking circuits are provided to insure that the sweeps are displayed in the proper sequence.

SECTION 4
PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5, for list of test equipment required.

All tests are performed with a representative Type 766H Series Main Frame Oscilloscope and a Y Amplifier Plug-in. Both of the plug-in units must be normalized to the Main Frame before starting tests. This is accomplished by adjusting the front-panel screwdriver SWP CAL and GAIN CAL controls as described in the appropriate Plug-in Instruction Manuals. Allow 30 to 60 minutes of warm-up time before making any adjustments.

NOTE

If this Plug-in module is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined in the paragraphs to follow, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

4.2. CHECKING SWEEP CALIBRATION

1. Connect a Time-Mark Generator to the Input connector of the Y Plug-in through a properly terminated cable.

2. Set up the instrument for Sweep B. Sweep accuracy is checked by counting the positive peaks in the centered 8-division portion of the CRT scale. Make sure the UNCAL lamp is off and refer to the following Sweep Check Calibration Chart for additional data.

3. Repeat checks for Sweep A position.

4-3. CHECKING TRIGGER SOURCE AND POLARITY

1. Preset front-panel controls as indicated:

Control	Setting
A & B TRIG LEVEL	Zero
HORIZONTAL DISPLAY	B
A & B Trigger SOURCE	LINE
A & B Trigger COUPLING	AC
A & B Trigger SLOPE	+
A & B Time/DIV	10 mSEC
A & B VERNIER	CAL (fully ccw)
VOLTS/DIV (Y Plug-in)	CAL
PULL X10	Pushed in (X1)
POSITION	Centered

SWEEP CHECK CALIBRATION CHART

TIME-MARK GEN set to	TIME/DIV set to	NUMBER OF POSITIVE PULSES*
10 MHz sine wave	0.05 μSEC	5 peaks
50 MHz sine wave	0.1 μSEC	(5 peaks**)
10 MHz sine wave	0.1 μSEC	9 peaks
5 MHz sine wave	0.2 SμEC	9 peaks
1 μSEC marker	0.5 μSEC	5 timing markers
1 μSEC marker	1.0 μSEC	9 timing markers
1 μSEC marker	2.0 μSEC	17 timing markers
5 μSEC marker	5 μSEC	9 timing markers
10 μSEC marker	10 μSEC	9 timing markers
10 μSEC marker	20 μSEC	17 timing markers
50 μSEC marker	50 μSEC	9 timing markers
100 μSEC marker	0.1 mSEC	9 timing markers
100 μSEC marker	0.1 mSEC	17 timing markers
500 μSEC marker	0.5 mSEC	9 timing markers (2**)
1 mSEC marker	1.0 mSEC	9 timing markers
1 mSEC marker	2.0 mSEC	17 timing markers
5 mSEC marker	5.0 mSEC	9 timing markers
10 mSEC marker	10 mSEC	9 timing markers
10 mSEC marker	20 mSEC	17 timing markers
50 mSEC marker	50 mSEC	9 timing markers
100 mSEC marker	0.1 SEC	9 timing markers
100 mSEC marker	0.2 SEC	17 timing markers
500 mSEC marker	0.5 SEC	9 timing markers
1 SEC marker	1 SEC	9 timing markers
1 SEC marker	2 SEC	17 timing markers

* Centered 8-division of scale.

** Expander check (Pull X10 switch out). Number of positive pulses between center 8 div, ±0.4 div are indicated by numbers in parenthesis. Neglect the first 50 nanoseconds of the sweep.

2. Six cycles of the calibrator pattern should be observed on the screen for a 60-cycle line, 5 cycles for 50-cycle line.

3. Set Sweep B Trigger SOURCE switch to INT; the pattern should remain stationary on the screen.

4. Set HORIZONTAL DISPLAY switch to A and adjust the Sweep A LEVEL control until the calibrator pattern appears on screen.

5. Set the Sweep A Trigger SOURCE switch to INT. The display should remain stationary on screen.

6. Set Y VOLTS/DIV switch to 0.5. Set both TIME/DIV switches to 1 usec. Apply a 0.5 volt, 1 MHz sine wave signal to Y Plug-in.

7. Adjust Sweep A LEVEL control to a point so that the trace remains on screen while switching the Trigger SLOPE switch back and forth from + to −.

8. Apply the 0.5 volt, 1 MHz sine wave to Sweep A EXT Input. Set Sweep A Trigger SOURCE to EXT. Repeat the above.

9. Set HORIZONTAL DISPLAY switch to B. Repeat steps 7 and 8 by replacing "Sweep B" for "Sweep A".

4-4. AUTO TRIGGERING AND HF SYNC CHECK

1. Set TIME/DIV switch to 10 mSEC and Sweep Mode Toggle switch to NORMAL.

2. Apply a very low frequency signal (about 20 Hz) to the Y plub-in. Check if the oscilloscope can be triggered properly, use DC coupling if needed. Switch Toggle switch to AUTO. Check whether the unit still is triggered properly. Check whether the unit free runs after the removal of triggering signal of 20 Hz up to about 10 MHz. Free-running should stop immediately after the reapplication of triggering signal.

3. Set Toggle switch to HF RECUR. Set TIME/DIV switch to 0.05 μSEC. Apply 50 MHz sine wave to the Type 76-08 Plug-in. Adjust the oscilloscope to obtain 1 division of vertical deflection. Using internal trig (or trig externally at 100 mv 50 MHz input), adjust Sweep B Trig LEVEL control to get a steady trace.

4. Set Toggle switch to NORMAL.

4-5. ALTERNATE DISPLAY CHECK

1. Apply 100 μSEC marker signal to CH 1 of the Y plug-in. Apply 10 KHz square wave (or 10 KHz sine wave) to CH 2 of the Y plug-in. Set MODE switch to ALT.

2. Set HORIZONTAL DISPLAY switch to ARMED B INTENS BY A. Set both SOURCE switches to INT. Set both coupling switches to LF REJECT. Set Sweep B TIME/DIV switches to 0.1 mSEC and Sweep A TIME/DIV switch to 20 μSEC. Adjust A & B LEVEL controls to get a steady pattern (with 2 cycles of trace brightened).

3. Set HORIZONTAL DISPLAY switch to ARMED ALT. Four steady traces should be observed on the screen. Adjust Y TRACE SEPARATION front-panel screwdriver control if the traces are overlapped.

4. Set HORIZONTAL DISPLAY switch to A & B ALT. Apply external triggering marker signal to Sweep A Input connector. Apply square wave (or sine wave as applied to CH 2 of Y plug-in) to Sweep B Input connector. Set both SOURCE switches to EXT.

5. Two steady traces should be seen on screen. Removing either signal (disconnect from Generator), the other trace should stay and a base line replaces the removed signal. Removing both signals, two base lines will be seen.

6. Reapply signals to both Y Channels and X plug-in EXT inputs. Turn Sweep B and/or Sweep A TIME/DIV switches to test proper independent control.

7. Adjust Sweep A VERNIER control and Sweep B VERNIER control for proper operations (smooth variation of over 2.5:1 range and on and off of UNCAL lamp).

8. Set both SOURCE switches to INT. Set HORIZONTAL DISPLAY switch to TRIGGERED ALT. Four traces should be seen on screen.

9. Turning DELAY VERNIER dial, the 2nd, 4th trace and the strobed portion of the 1st and 3rd trace will move along.

10. Set Y MODE switch to CH 2 and CH2 VOLTS/DIV switch to 2. Apply 10 KHz sine wave signal of 1 cm deflection to CH2 and X AMP Input. Set HORIZONTAL DISPLAY switch to B WITH X. Set Sweep A SOURCE switch to EXT, COUPLING switch to DC, SLOPE switch to + and LEVEL control (X AMP VARIABLE) fully cw.

11. Two traces should be seen: B Sweet and X-Y Plot.

12. Set CH 2 VOLTS/DIV to CAL. Set HORIZONTAL DISPLAY switch to A & B ALT. Both TIME/DIV switches to AC. Adjust LEVEL controls to get two traces.

13. Set HORIZONTAL DISPLAY switch to SINGLE. Set both SOURCE switches to EXT. Push REARM Light button and note the REARM lamp should be turned on.

14. Set Sweep B SOURCE switch to LINE and note that the sweep fires only once. The REARM lamp should be turned off at the conclusion of the single-sweep cycle. Set SOURCE switch to EXT.

15. Push the REARM button again. The REARM light should turn on. Set Sweep A SOURCE switch to LINE and note that the sweep fires only once. The REARM light is turned off. Set Sweep A SOURCE switch to EXT.

16. Set both TIME/DIV to 0.1 sec. Set DELAY VERNIER dial to 10. Repeat Steps 14 and 15. Note that Sweep A fires immediately, while Sweep B waits about 1 second before firing, after setting SOURCE switch to LINE.

SECTION 5
MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION

This section of the manual contains service information and procedures for internal adjustments.

5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in this instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of Fairchild to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field Representative maintains a limited number of spare parts. Also the factory may be asked to air-ship replacement parts on a rush basis.

The procedure for replacing most parts in this instrument is obvious, therefore specific instructions for their removal are not required.

NOTE: Be sure and replace the beryllium oxide insulating washers (they serve as heat sinks) on the transistors that require them. Always grease these heat sinks with Dow Corning silicon grease for optimum heat transfer.

5-3. SERVICING HINTS

General maintenance and trouble-shooting information is given in the Type 766H Series Oscilloscope Instruction Manual. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble in the Time Base Plug-in unit.

In trouble shooting a plug-in unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble shooting this unit, refer to the functional block and timing diagrams and to the Schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate the plug-in after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper performance of the Plug-in unit, the following suggestions are recommended:

1. The Type 4294 Extension Cable for remote operation of the plug-in from the oscilloscope is available as an accessory. This plug-in extender will be helpful for routine maintenance and recalibration. Do not use this extension for HF alignments; instead remove the Main Frame side cover.

2. Localizing the trouble is made easier by use of a test oscilloscope to check waveforms. These waveforms are shown at key points on the over-all schematics. Both the waveform amplitude and time duration are given. Use a high-impedance 10:1 Passive Attenuator Probe while trouble shooting (Fairchild Type 4290 Series). A Fairchild Type 766H Series Oscilloscope with a Y Plug-in having a bandwidth from dc to 25 Mc is recommended.

3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

4. When using accessory probes or adapters be sure the trouble is not originating in the accessory before suspecting the instrument itself.

5. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by

voltage measurement. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

6. The identification of electron tubes, semi-conductors and service adjustments are shown on photographs in this Section of the Instruction Manual.

5-4. GAINING ACCESS TO CHASSIS

Since the Plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

WARNING

WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115V/230V ±2%.

To set up the Time Base Unit for calibration, insert an amplifier plug-in and the Time Base Plug-in into the Main Frame. The amplifier plug-in module and the Main Frame must be fully tested and certified units.

CAUTION

Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in this instrument may be damaged if overvoltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

b. Test Equipment Required (Equivalent may be substituted)

Type	Description
Oscilloscope	Fully tested and certified Type 766H Main Frame
Y Plug-In	Type 76-08 Dual Trace
X Plug-In	Type 74-03A
Volt-Ohmmeter	Simpson Model 260; 20K ohms/volt sensitivity
Square Wave Generator	Fairchild Type 791A
Time-Mark Generator	Fairchild Type 781A
Vacuum Tube Voltemter	Hewlett-Packard Model 410B
Differential Voltmeter	John Fluke Model 801
Type 4290	10:1 Passive Attenuator Probe
Alignment Tools	Fairchild Type 7013 Tool Kit
Oscillator	Hewlett-Packard Model 650A

Preset Type 74-17A panel controls as follows:

Control	Setting
Trigger Mode	AUTO
Horizontal Display	B
A&B Trigger SOURCE	LINE
A&B Trigger COUPLING	DC
A&B Trigger SLOPE	+
A&B TIME/DIV	5 mSEC
A&B VERNIER	CAL (fully cw)
VOLTS/DIV (Y Plug-in)	CAL
PULL X10	Pushed in (X1)
POSITION	Centered

5-6. SWEEP A & B TRIG SENS ADJUSTMENT (R8126 & R8322)

1. Preset front-panel controls as indicated:

Control	Setting
HORIZONTAL DISPLAY	B
B Trigger SOURCE	EXT

2. While gently rocking the Sweep B LEVEL control back and forth, turn the B TRIG SENS potentiometer R8126, gradually clockwise until a trace just appears on the screen. This indicates that tunnel diode CR8101 is now free-running.

3. Back off on the B TRIG SENS potentiometer R8126 until the trace just disappears. Turn the B LEVEL control back and forth and note the trace flashes momentarily on the screen but disappears when the B LEVEL control is not turned.

4. Preset front-panel controls as indicated:

Control	Setting
HORIZONTAL LOGIC	A
B Trigger SOURCE	LINE
A Trigger SOURCE	LINE

5. Adjust the Sweep A LEVEL control for a trace on the screen.

6. Set a Trigger SOURCE switch to EXT; the trace should disappear.

7. While gently rocking the A LEVEL control, turn the A TRIG SENS potentiometer R8322 gradually clockwise until a trace just appears on the screen. This action indicates that tunnel diode CR8301 is now free-running.

8. Back off on the A TRIG SENS potentiometer R8322 until the trace just disappears. Rock the A LEVEL control and note that the trace appears momentarily on the screen but disappears when the A LEVEL control is not turned.

5-7. X AMPLIFIER OUTPUT LEVEL ADJUSTMENT (R8544)

1. Set the HORIZONTAL DISPLAY switch to B.

2. Set B Trigger SOURCE switch to EXT.

3. Connect a Simpson Voltmeter across the output leads to the deflection plates P8001, pin 17 to pin 1.

4. Turn the Positioning control until the voltage reads zero or less than ¼ volt on the 2.5V scale.

5. Connect the Voltmeter from P8001, pin 1 (or pin 17) to ground. Set to 250V scale.

6. Adjust R8544 AMP LEVEL potentiometer to 89 volts, ±1V. (Make sure that the measurement does not introduce any oscillation in the X Amplifier.)

7. Carefully disconnect meters.

5-8. SLOW SWEEP CALIBRATION, SWEEP RATE BALANCE, SAW DC LEVEL AND TRACE SEPARATION (R8889, R8623, R8239 & R8465)

1. Preset front-panel controls as indicated:

Control	Setting
Type 74-17A	
HORIZONTAL DISPLAY	A & B ALT
A & B Trigger SOURCE	INT
A & B Trigger COUPLING	LF REJECT
A & B Trigger SLOPE	+
A & B TIME/DIV	0.5 mSEC
A & B VERNIER	Fully cw
Dual Trace Y Plug-in	
MODE	CH 1
VOLTS/DIV	2

NOTE: Make sure the UNCAL lamp is not lit on the Type 74-17A.

2. Apply 0.5 millisecond marker signal from a Fairchild Type 781A Time Mark Generator to Channel 1 input of the dual trace Y plug-in.

3. Adjust A & B LEVEL controls to obtain a steady trace.

4. Adjust TRACE SEPARATION (R8889) front-panel screwdriver control if the traces are overlapped.

5. Adjust SWP CAL front-panel screwdriver control (R8623R) until 11 markers occupy precisely 10 divisions.

6. Adjust Sweep Rate Balance potentiometer R8239 and Saw DC level potentiometer R8465 so that the two traces start at nearly the same line and until optimum calibration (11 markers in 10 divisions) is obtained for both. The SWP CAL control may have to be readjusted.

5-9. SWEEP LENGTH AND X10 REGISTRATION (R8474, R8229, R8512)

1. Adjust A & B SWEEP LENGTH potentiometers R8474 & R8229 until the display occupies 10.5 to 10.7 divisions.

2. Set Y VOLTS/DIV switch to CAL. Set HORIZONTAL DISPLAY switch to B and the TIME/DIV switch to 5 mSEC.

3. Position the pattern so that the leading edge of one of the calibrator pulses is coincident with the vertical center line of the scale.

4. Pull out the X10 knob (concentric with the HORIZONTAL DISPLAY knob).

5. Adjust the X10 REGISTRATION potentiometer R8512 until the leading edge of the same pulse (see step 4) is again coincident with the vertical center line of the scale (within ±½ div).

6. Push in the X10 knob.

5-10. X AMPLIFIER HIGH-FREQUENCY ADJUSTMENT (C8318, C8511, C8519, C8301)

1. Replace the dual trace plug-in amplifier in the Y cavity with a tested time base plug-in unit (74-03A). This unit is then set up to obtain a vertical sweep.

Note: Unless otherwise noted, the test procedure for the balance of this set-up pertains to the time base unit inserted in the X cavity.

1. Set HORIZONTAL DISPLAY switch to X AMP, Trigger SOURCE switch to EXT, COUPLING switch to DC and SLOPE switch to +.

3. Turn X AMP VARIABLE control fully clockwise.

4. Apply a 100 KHz square wave signal from the Fairchild Type 791A Square Wave Generator through a properly terminated 50-ohm cable to the X AMP input connector on the Type 74-17A.

5. Using EXT Triggering for the Time Base Plug-in in the Y cavity, obtain a steady trace. (Inter-

connect between the TRIG OUT on the Type 791A connector to the EXT TRIG connector on the Time Base Plug-in.)

6. Adjust amplitude of the square wave pattern for 2 divisions peak-to-peak about the scale center. If the output of the Type 781A Generator is not sufficient, set its front-panel SOURCE IMPEDANCE switch to NORMAL.

7. Adjust trimmer C8318 for flat-top display.

8. Set the Type 791A Square Wave Generator to 1 MHz and adjust oscilloscope controls for a 2-cycle pattern on the screen.

9. Center the pattern and adjust amplitude of the square wave display for 2 divisions peak-to-peak about the scale center.

10. Adjust trimmers C8511 and C8518 until the best flat-top and rise time are achieved.

11. Pull out the X10 control (concentric with HORIZONTAL DISPLAY switch). Insert a 20 db pad in series with the signal input cable (or reduce the square wave amplitude). Check whether the previous display is obtained.

12. Set square wave generator to 100 KHz. Adjust oscilloscope controls for several cycles of the display to be observed on the screen.

13. Pull out the Sweep A EXT/10 switch. Remove the 20 db pad (or increase square wave amplitude). Adjust C8301 for flat-top display.

14. Disconnect the Type 791A Square Wave Generator. Push in the Sweep A EXT/10 switch and the X10 Magnification control. Replace the Type 74-03A Time Base unit in the Y cavity with the Dual Trace Y Plug-in (Type 76-08).

5-11. DC BALANCE AND X AMP CENTER (R8310, R8339)

1. Set VOLTS/DIV switch to CAL.

2. Set HORIZONTAL DISPLAY switch to B WITH X, Sweep B SOURCE switch to INT, and the front panel Toggle switch to AUTO, and A SOURCE switch to EXT.

3. A horizontal trace and a vertical line should be seen on the screen. Adjust X AMP CENTER potentiometer R8339 so that the vertical line is at the screen center.

4. Adjust DC BAL potentiometer R8310 until there is no horizontal depositioning of the trace while rocking the X AMP VARIABLE control throughout its range.

5-12. FAST SWEEP CALIBRATION (C8613, C8217, C8604, C8424, C8519, C8521, C8423 & C8216)

1. Set the HORIZONTAL DISPLAY switch to B, A & B TIME/DIV switch to 1 μsec, A & B SOURCE switches to INT, and A & B COUPLING switches to LF REJ.

2. Apply a 1 microsecond time marker signal from a Fairchild Type 781A Time Mark Generator to the input connector of the Y plug-in.

3. Adjust the VOLTS/DIV switch to give the display a vertical amplitude of about 2½ divisions.

4. Using an insulated screwdriver, adjust trimmer C8613 and C8217 until 11 markers occupy 10 divisions evenly.

5. Set HORIZONTAL DISPLAY switch to A. Adjust C8604 and C8424 until 11 markers occupy 10 divisions evenly.

6. Set HORIZONTAL DISPLAY switch to B, and A & B TIME/DIV switches to 0.1 μsec.

7. Switch the Fairchild Type 781A Time Mark Generator to 10 MHz. If necessary, adjust C8217 until 11 peaks occupy 10 divisions evenly.

8. Set HORIZONTAL DISPLAY switch to A. If necessary, adjust C8424 until 11 peaks occupy 10 divisions evenly.

9. If necessary, repeat steps 5, 6, 7 and 8.

10. Switch the frequency of the Type 781A Time Mark Generator to 50 MHz. Pull out the X10 Magnification control. A 4-cycle sine wave display should be observed within the center 8-division portion of the graticule. If not, trim up with capacitors C8519 and C8524 to bring the calibration within 5%.

11. Set HORIZONTAL DISPLAY switch to B. Repeat the above check. All measurements should be made beyond the first 50 nanoseconds.

12. Set both TIME/DIV switches to 0.05 μsec. A two-cycle sine wave display should be observed within the centered 8-division to within 5% accuracy. If necessary readjust C8519 and C8521 to obtain a compromise between these two sweep ranges.

13. Set HORIZONTAL DISPLAY switch to A TRIG DLYD. Repeat step 12.

14. Position the sweep so that the portion of the sweep after the first 50 nanoseconds is shown on screen. Adjust C8423 to get the best calibration. Switch HORIZONTAL DISPLAY to B. Repeat the above by adjusting C8216. A compromise may be necessary between the last two sweep ranges.

5-13. STROBE INTENSITY AND PATTERN CORRECTION ADJUSTMENT (R8409, C8403)

1. Set HORIZONTAL DISPLAY switch to B INTENS BY A Triggered and set B Sweep SLOPE switch to +. Push in X10 Magnification control.

2. Set B Sweep TIME/DIV to 50 μsec. Set A Sweep TIME/DIV to 2 μsec. Set Type 781A Time Mark Generator to 5 msec.

3. Vary DELAY VERNIER control until the strobed section of the display is in the middle of the trailing edge of the marker signal.

4. Adjust Brightness control R8413 until a distinct contrast is produced.

5. The strobed section may be offset from the unstrobed marker trace. Adjust the strobe Pattern Correction R8409 until they are coincident.

6. Set Type 781A Time Mark Generator to 100 μsec. Set B TIME/DIV switch to 0.5 μsec and A TIME/DIV to 0.05 μsec.

7. Vary DELAY VERNIER control until the strobed section of the display is in the middle of the trailing edge of the marker signal.

8. Adjust trimmer C8403 for minimum overshoot at both ends of the strobed section.

5-14. DELAY ZERO ADJUSTMENT (R8274)

1. Set B TIME/DIV switch to 0.1 msec. Set A TIME/DIV switch to 0.1 μsec.

2. Turn DELAY VERNIER dial to zero.

3. If the strobed section is still visible, adjust the Delay Zero potentiometer R8274 until the strobed section just disappears.

5-15. DELAY CAL ADJUSTMENT (R8271)

1. Apply a 100 microsecond time-marker signal from a Fairchild Type 781A Generator to Input Connector on the Y plug-in.

2. Set Sweep B TIME/DIV switch to 0.1 msec and Sweep A TIME/DIV switch to 5 μsec.

3. Set DELAY VERNIER dial to 5 div and adjust the Delay CAL potentiometer R8271, so that the strobed section starts approximately at the 5-division mark.

4. Position the display so that the pulse is bisected by the vertical center line, ±0.05 division.

6. Advance the DELAY VERNIER dial to 5.8 div. (Be sure that the Positioning and the Trigger Level settings are not disturbed.)

7. Adjust the Delay Cal Potentiometer R8371 so that the pulse is again centered, ±0.05 division.

8. Back-off DELAY VERNIER dial to 0.8 div and check whether or not the pulse is again centered. If not, center the pulse and recheck step 7. This procedure may have to be repeated several times until the 0.8 div pulse and the 5.8 div pulse are centered, ±0.05 div.

9. Measure the incremental accuracy of the delay calibration from 0.8 div to 9.8 div in steps of 1 div (i.e., 1.8 div, 2.8 div, etc.). One complete revolution of the DELAY VERNIER dial say from 3.8 div to 4.8 div, should bring the succeeding pulse back to the position occupied by the preceding pulse within ±1 div. (Be sure that the Positioning and Trigger Level settings are not disturbed during this check.)

10. Center the pulse when the dial is set at 9.8 div. Turning the dial back to 0.8 div should bring the pulse back on screen within ±2 div from the center line.

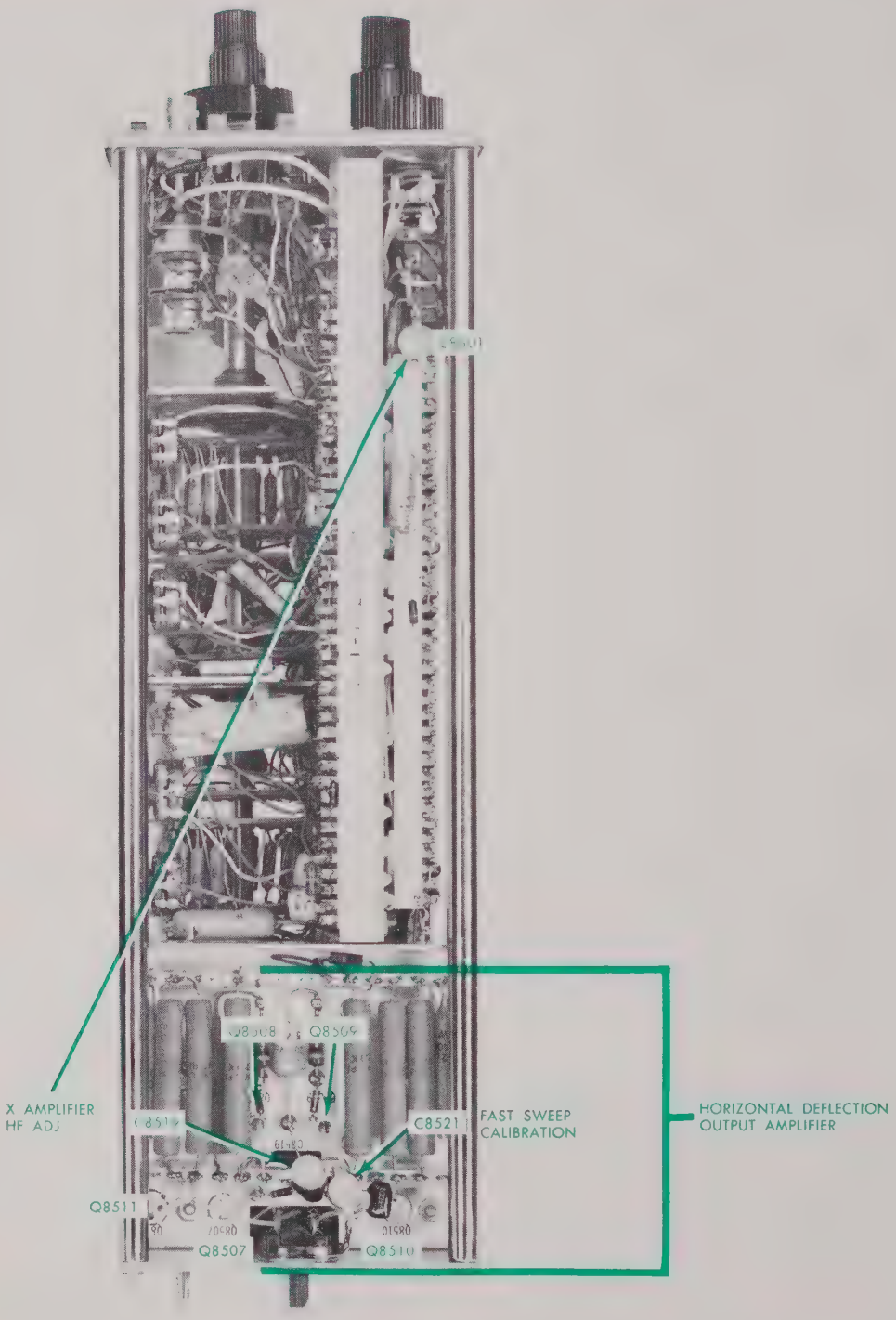


Figure 5-1. Transistor & Trimmer Locations (Top View)

TRANSISTORS IDENTIFIED

Symbol	Function
Q8101 Q8102	Trig B Ampl
Q8103	Trig B Shaper
Q8201 Q8202	Sweep B Multi
Q8203	Sweep B Turn-off
Q8206	Sweep B Integrator
Q8207	Saw B Output
Q8301 Q8302	Trig A Ampl
Q8303	Trig A Shaper
Q8403 Q8404	Sweep A Multi
Q8408	Sweep A Integrator
Q8409	Sweep A Turn-off
Q8410	Saw A Output
Q8501	Hor-Defl Emit Foll
Q8502 Q8503	Common Emit Foll
Q8504	+ 23V Emit Foll
Q8505 Q8506	Emit Foll (Hor)
Q8805	Sweep B Gate
Q8808	-15V Source
Q8814	Sweep A Gate
Q8815	X Pre-Ampl Gate

Figure 5-2. Transistor Locations, Right Side (Partial)

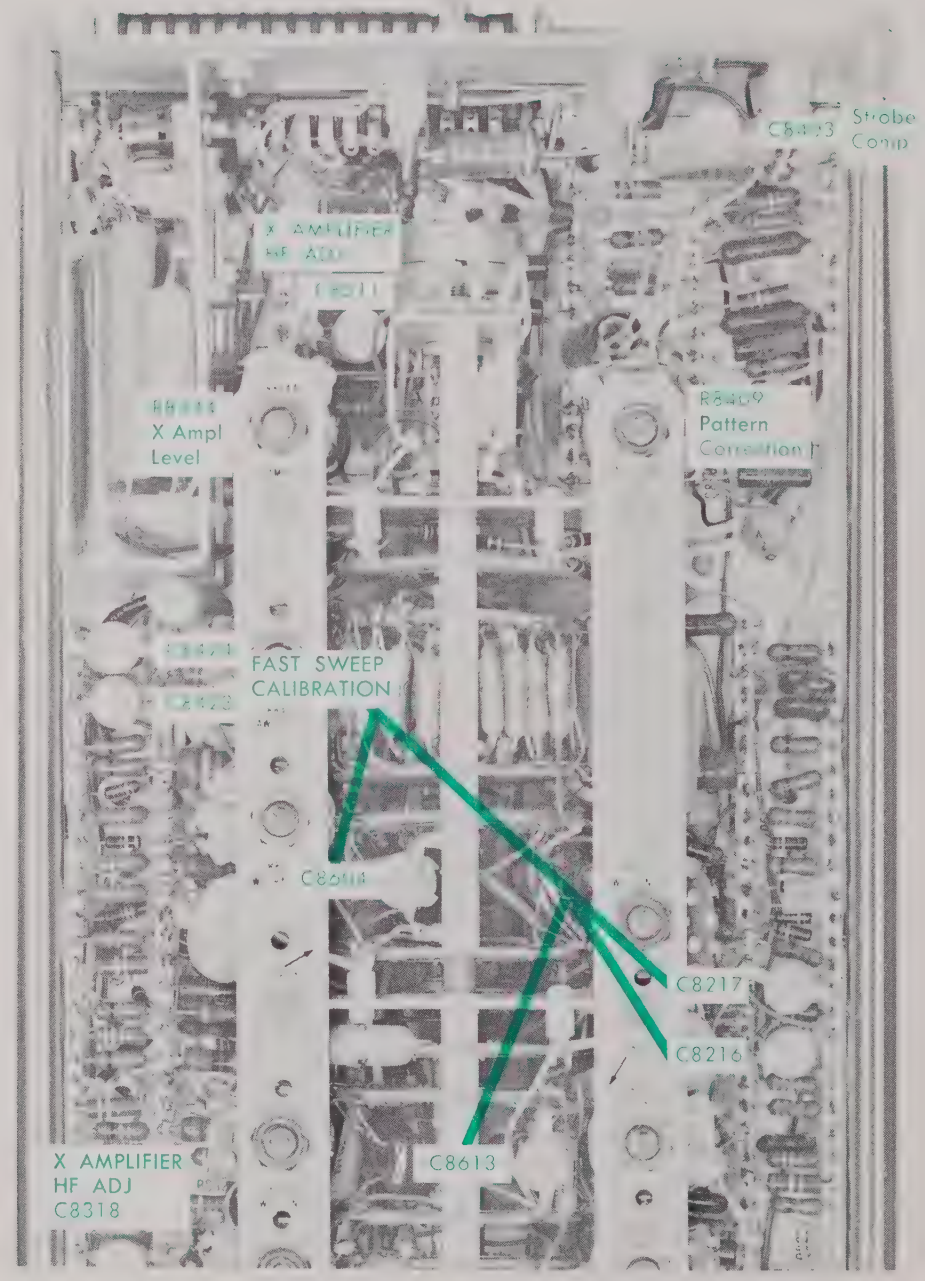


Figure 5-3. Service Adjustments, Right Side (Partial)

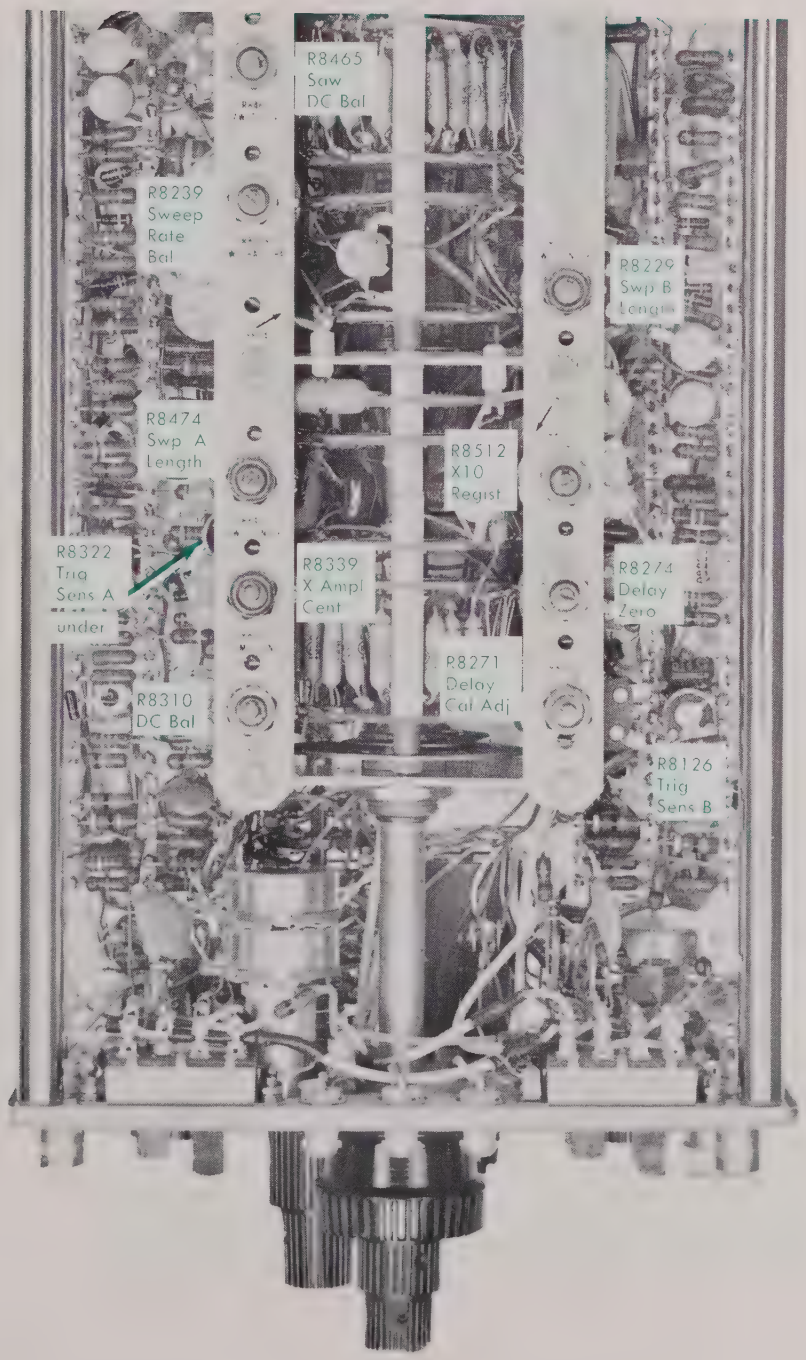
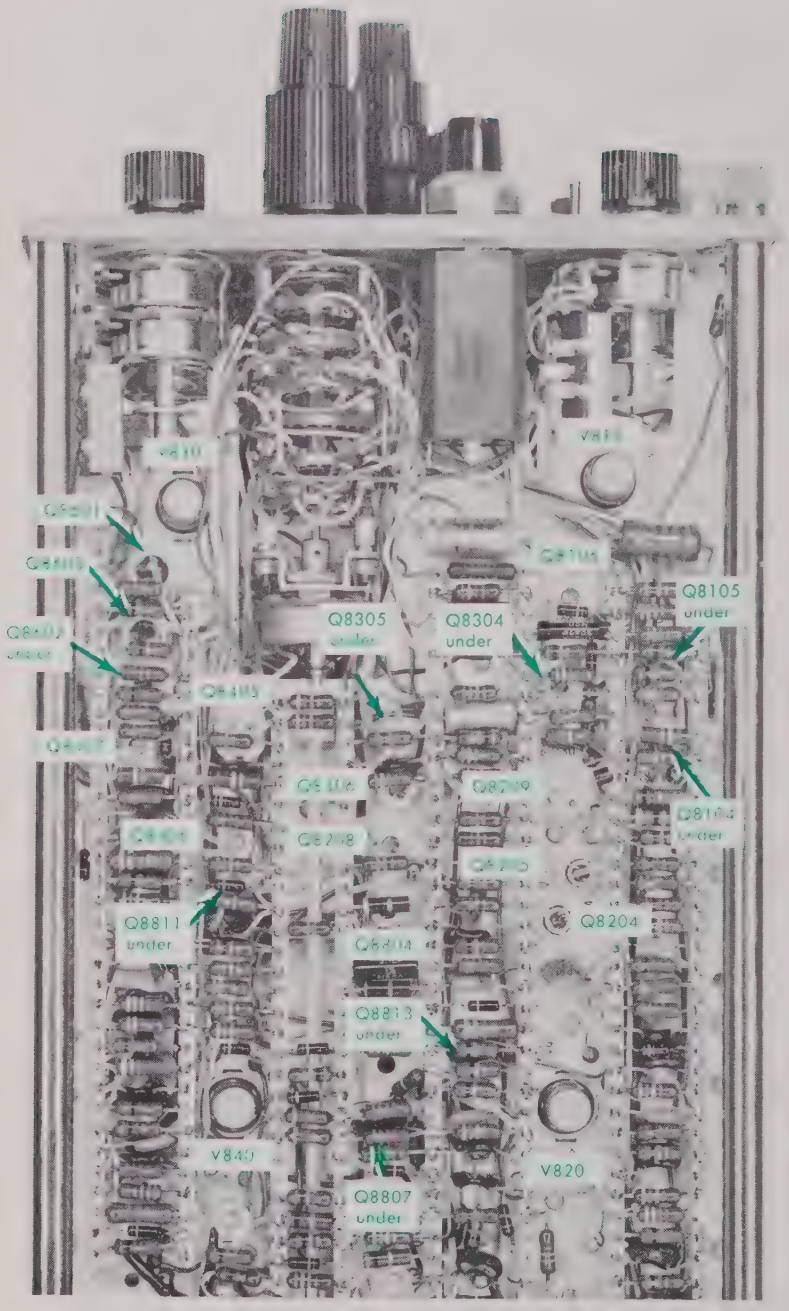


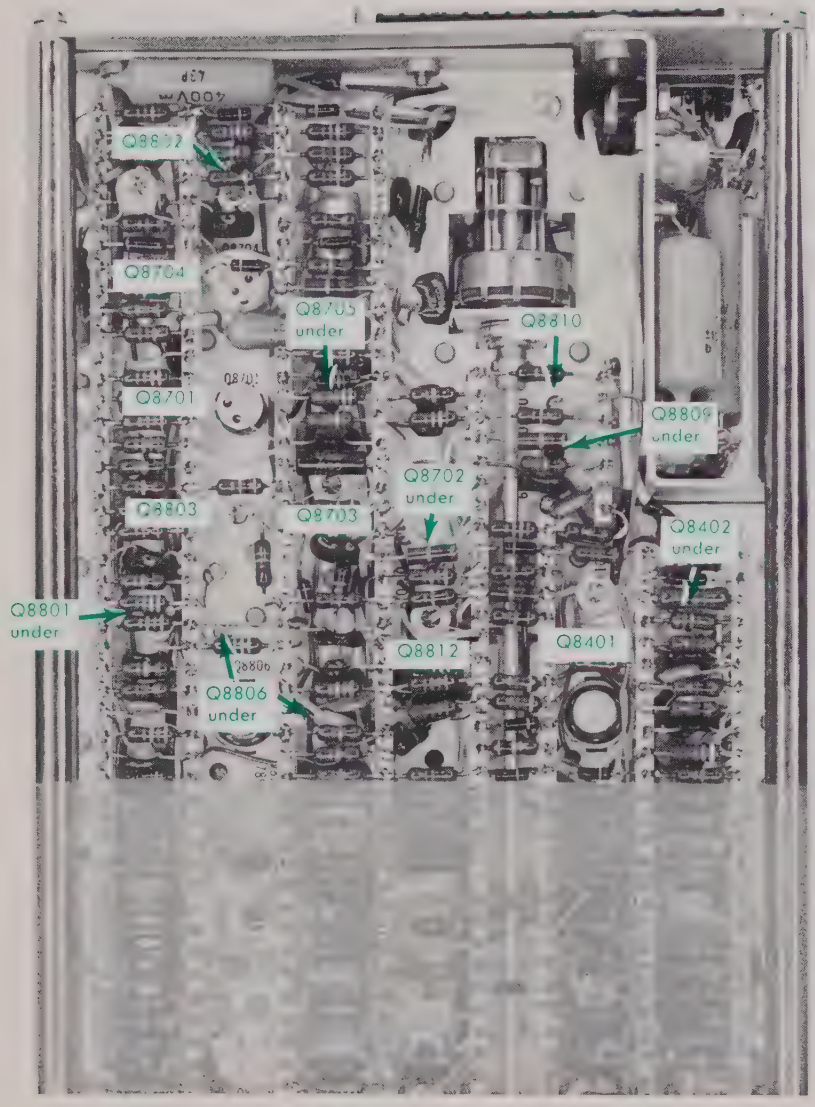
Figure 5-4. Service Adjustments, Right Side (Partial)



TRANSISTORS IDENTIFIED

Symbol	*Function*
V810	Trig B CF
V820	Saw B Integrator
V830	Trig A CF
V840	Saw A Integrator
Q8104 Q8105 Q8106	Sweep B Auto Trig
Q8204 Q8205 Q8209	Delayed Trig Pick-off
Q8208	Delayed Trig Output
Q8304 Q8305 Q8306	Sweep A Auto Trig
Q8405	Rearm
Q8406 Q8407	Armed Multi
Q8601	Swp A Charging
Q8602 Q8603	Swp B Charging
Q8804	A Turns off B
Q8807	Electronic Switch
Q8811	Strobe Eliminator
Q8813	B Turns off A

Figure 5-5. Transistor & Nuvistor Locations, Left Side (Partial)



TRANSISTORS IDENTIFIED

Symbol	*Function*
Q8401 Q8402	Strobe
Q8701 Q8702 Q8703	Unblanking Amplifiers
Q8704	Unblanking Follower
Q8705	Electronic Switch Driver
Q8801	X-Y Tie
Q8802	Dual Alt Trig
Q8803	Swp B Blanking
Q8806	Electronic Switch
Q8809 Q8810	Trace Separation
Q8812	Sweep A Blanking

Figure 5-6. Transistor Locations, Left Side (Partial)

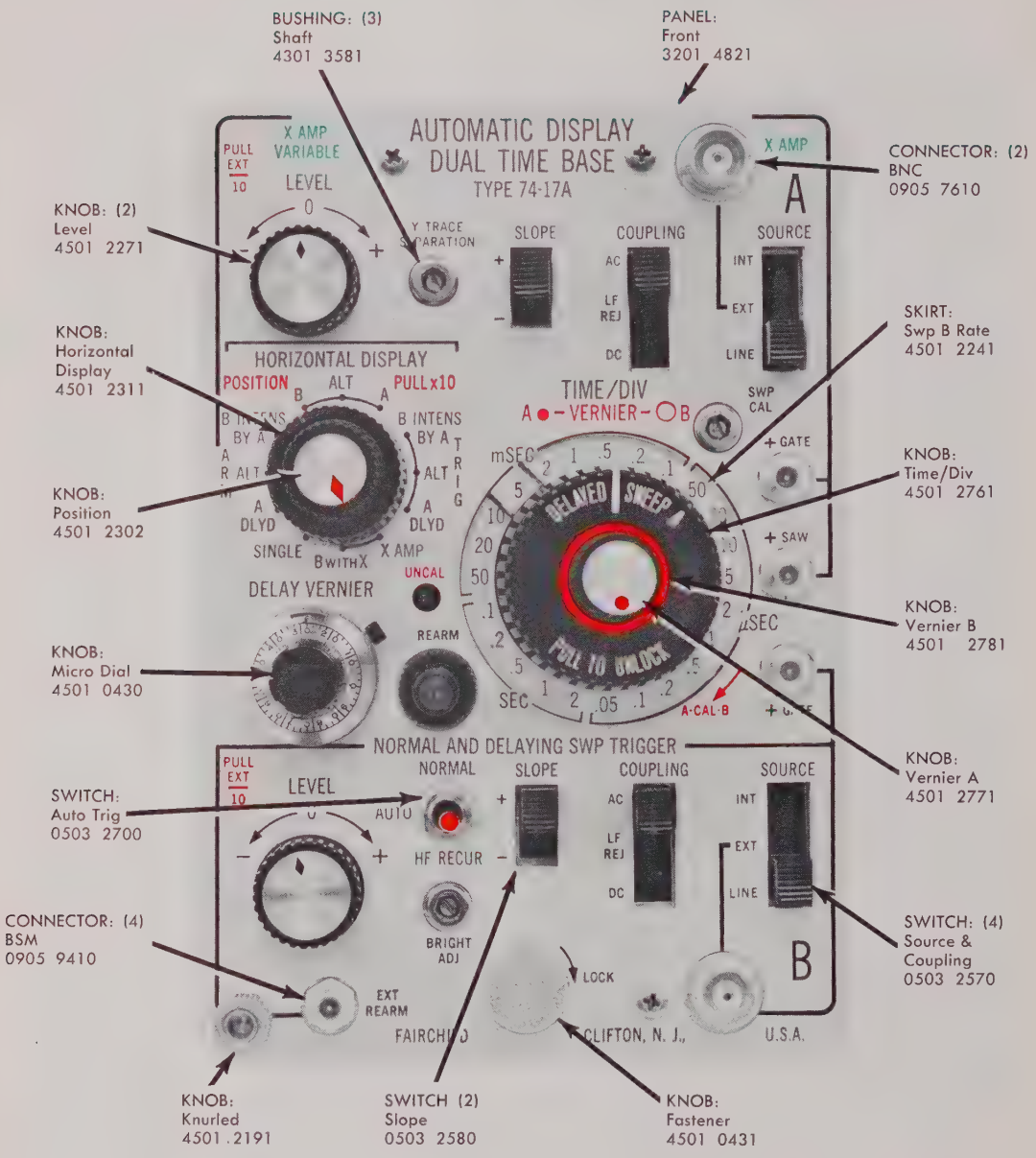


Figure 6-1. Front Panel Replaceable Part

SECTION 6
ELECTRICAL PARTS LIST AND SCHEMATICS

TYPE 74-17A AUTOMATIC DISPLAY DUAL TIME BASE PLUG-IN

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8101	0316 7200	4.7 pf, ±0.25%	ERC	NPOSI-1
C8102	0326 4520	0.001 μf, GMV	ERC	831
C8103	0315 3720	2200 pf, +100% —0%	ERC	
C8104	0315 2000	100 pf, ±10%	EIA	
C8106	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8107	0316 9520	2200 pf, ±10%, 1000V	RMC	JL
C8108	0314 6860	5.6 pf, ±1%	EIA	
C8109	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8111	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8112	0317 5320	mica, 150 pf, ±5%	EMC	DM15
C8113 & C8114	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8116	0316 9520	2200 pf, ±10%, 1000V	RMC	JL
C8117	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8118	0327 3420	electrolytic, 10 μf, —10% +75%, 6V	SPG	30D
C8119	0317 5250	mica, 75 pf, ±5%	EMC	DM15
C8201	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8202 & C8203	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8204	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8206	0317 5470	mica, 510 pf, ±5%, 300V	EMC	DM15
C8207	0317 5360	mica, 220 pf, ±5%	EMC	DM15
C8208	0319 1060	0.01 μf, +60% —40%,150V	CRL	DDM
C8209	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8211 & C8212	0317 5190	mica, 47 pf, ±5%	EMC	DM15
C8213	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8214	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8216	0326 9510	variable, 2.5-11 pf, 200V	ERC	538
C8217	0326 9480	variable, 9-35 pf, 100V	ERC	538
C8218	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8219	0319 1050	0.02 μf, +60%, 150V	CRL	DDM
C8220	0317 5210	mica, 51 pf, ±5%	EMC	DM15
C8221	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8222	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8223	0316 9520	2200 pf, ±10%, 1000V	RMC	JL
C8224	0326 7630	electrolytic, 10 μf, —10% +100%, 50V	SPG	
C8226	0319 1060	0.01 μf, +60% —40%, 150V	CRL	DDM
C8301	0326 9490	variable, 2-8 pf, 200V	ERC	538
C8302	0326 4520	0.001 μf, GMV	ERC	831
C8303	0315 3720	2200 pf, +100% —0%	ERC	
C8304	0315 2000	100 pf, ±20%	EIA	
C8306	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8307	0316 9520	2200 pf, ±10%, 1000V	RMC	JL
C8308	0314 6860	5.6 pf, ±1%	EIA	
C8309	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8311	0315 3720	2200 pf, +100% —0%	ERC	DDM
C8312	0317 5320	mica, 150 pf, ±5%	EMC	DM15
C8313 & C8314	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8316	0317 5370	mica, 240 pf, ±5%	EMC	DM15
C8317	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8318	0326 9480	variable, 9-35 pf, 100V	ERC	538
C8319	0316 9520	2200 pf, ±10%, 1000V	RMC	JL
C8321	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8322	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8323	0327 3420	electrolytic, 10 μf, —10% +75%, 6V	SPG	30D130A1
C8324	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8401	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8402	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8403	0326 9510	variable, 2.5-11 pf, 200V	ERC	538
C8404	0317 5370	mica, 240 pf, ±5%, 300V	EMC	DM15
C8406	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8407 & C8408	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8409	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8410	0317 5060	mica, 10 pf	EMC	DM15
C8411	0317 5190	mica, 47 pf, ±5%	EMC	DM15
C8412	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8413	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8414	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8415	0317 5060	mica, 10 pf, ±5%	EMC	DM15
C8416 & C8417	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8418	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8419	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8421	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8422	0326 7880	plastic, .22 μf, ±10%, 200V	AMX	C296AB
C8423	0326 9510	variable, 2.5-11 pf, 200V	ERC	538
C8424	0326 9480	variable, 9-35 pf, 100V	ERC	538
C8426	0319 1060	0.01 μf, +60% —40%, 150V	CRL	DDM
C8427	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8428	0317 5060	mica, 10 pf, ±5%	EMC	DM15
C8429	0317 5320	mica, 150 pf, ±5%	EMC	DM15
C8432	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8501	0319 1060	0.01 μf, +60% —40%, 150V	CRL	DDM
C8502	0316 7200	4.7 pf, ±0.25	ERC	NPO331
C8503 & C8504	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8506	0317 5320	mica, 150 pf, ±5%	EMC	DM15
C8507	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8508	0317 5190	mica, 47 pf, ±5%	EMC	DM15
C8509	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8511	0326 9500	variable, 5.5-18 pf, 200V	ERC	538
C8512	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8513	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8514	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8515	0326 8080	plastic, 0.22 μf, ±10%, 400V	AMX	C296AC
C8516	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8517	0316 0240	16 pf, ±5%	EIA	
C8519	0326 9480	variable, 9-35 pf, 100V	ERC	538
C8521	0326 9480	variable, 9-35 pf, 100V	ERC	538
C8522	0317 5280	mica, 100 pf, +5%	EMC	DM15
C8601	0316 3850	47 pf, ±5%, 1000V	RMC	C
C8602	0316 3790	27 pf, ±5%, 1000V	RMC	C
C8603	0316 4180	9.1 pf, ±5%, 1000V	RMC	C
C8604	0326 9490	variable, 2-8 pf, 200V	ERC	538
C8606	0316 0300	30 pf, ±5%	EIA	
C8607	0327 8270	plastic, .86 μf, ±1%, 100V	GUD	F396-023A
C8608	0327 2090	plastic, .03866 μf, ±.5%, 100V	GUD	355B
C8609	0327 1510	plastic, 3831 μf, ±.5%	EMC	DM19
C8611	0327 1580	mica, 348 pf, ±.5%	EMC	DM19
C8612	0326 7620	electrolytic, 5 μf, 50V	SPG	

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8613	0326 9490	variable, 2-8 pf, 200V	ERC	538
C8614	0316 0300	30 pf, ±5%	EIA	
C8616	0327 8270	plastic, 0.86 μf, ±1%, 100V	GUD	F396-023A
C8617	0327 2090	plastic, 0.03866 μf, ±0.5%, 100V	GUD	355B
C8618	0327 1510	plastic, 3831 pf, ±.5%	EMC	DM19
C8619	0327 1580	plastic, 348 pf, ±.5%	EMC	DM19
C8621	0316 3850	47 pf, ±5%, 1000V	RMC	C
C8622	0316 3790	27 pf, ±5%, 1000V	RMC	C
C8623	0316 4180	9.1 pf, ±5%, 1000V	RMC	C
C8624	0326 7930	plastic, 1 μf, ±10%, 200V	AMX	C296AB
C8626	0319 6250	plastic, 0.05 μf, ±10%, 150V	GUD	338Y
C8627	0326 7980	plastic, 4700 pf, ±10%, 400V	AMX	C296AC
C8701 & C8702	0317 5170	mica, 39 pf, ±5%	EMC	DM15
C8703 & C8704	0319 1050	0.02 μf, +60% —40%, 150V	CRL	DDM
C8706	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C8707	0317 5750	mica, 1000 pf, ±5%, 100V	EMC	DM15
C8708	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8709	0326 8010	plastic, 0.015 μf, ±10%, 400V	AMX	C296AC
C8710	0317 5750	mica, 1000 pf, ±5%, 100V	EMC	DM15
C8711	0316 9440	470 pf, ±10%, 1000V	RMC	JL
C8712	0327 1630	electrolytic, 2 μf, —10 +100%, 100V	SPG	
C8713	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM
C8714	0317 5080	mica, 15 pf, ±5%	EMC	DM15
C8716	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8717	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8718 & C8719	0326 4520	0.001 μf, GMV	ERC	831
C8721	0317 5080	mica, 15 pf, ±5%	EMC	DM15
C8722 & C8723	0326 4520	0.001 μf, GMV	ERC	831
C8801	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8802	0317 5370	mica, 240 pf, ±5%	EMC	DM15
C8803	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8804	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8806	0317 5320	mica, 150 pf, ±5%	EMC	DM15
C8807	0317 5210	mica, 51 pf, ±5%	EMC	DM15
C8808	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8811	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8812	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8813	0317 5160	mica, 36 pf, ±5%	EMC	DM15
C8814	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8816 & C8817	0317 5160	mica, 36 pf, ±5%	EMC	DM15
C8818 & C8819	0317 5280	mica, 100 pf, ±5%	EMC	DM15
C8820	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8821	0317 5750	mica, 1000 pf, ±5%, 100V	EMC	DM15
C8822	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8861	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8862	0317 5150	mica, 33 pf, ±5%	EMC	DM15
C8864	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8866	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8867	0317 5160	mica, 36 pf, ±5%	EMC	DM15
C8868	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C8869	0317 5160	mica, 36 pf, ±5%	EMC	DM15
C8871 & C8872	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM

SEMICONDUCTORS

CR8101	2600 8150	diode, 1N3717	EIA	
CR8102 to CR8104	2600 6910	diode, FD841	FCI	
CR8105	2600 6820	diode, FD281	FCI	
CR8200 to CR8207	2600 6910	diode, FD841	FCI	
CR8208 & C8209	2600 8020	diode, FDG3091	FCI	
CR8211	2600 6910	diode, FD841	FCI	
CR8212	2600 9250	diode, IN3715	GI	
CR8213 & CR8214	2600 6910	diode, FD841	FCI	
CR8215	2600 8020	diode, FDG3091	FCI	
CR8216 to CR8218	2600 6910	diode, FD841	FCI	
CR8219	2600 6990	diode, 1N752	HOF	
CR8220	2600 6910	diode, FD841	FCI	
CR8221	2600 8020	diode, FDG3091	FCI	
CR8301	2600 8150	diode, 1N3717	EIA	
CR8302	2600 6910	diode, FD841	FCI	
CR8304	2600 6910	diode, FD841	FCI	
CR8306 to CR8309	2600 6910	diode, FD841	FCI	
CR8311 to CR8313	2600 6910	diode, FD841	FCI	
CR8314	2600 8020	diode, FDG3091	FCI	
CR8316	2600 6910	diode, FD841	FCI	
CR8401 to CR8413	2600 6910	diode, FD841	FCI	
CR8414	2600 8020	diode, FDG3091	FCI	
CR8415	2600 6910	diode, FD841	FCI	
CR8416	2600 6990	diode, 1N752	HOF	
CR8417 & CR8418	2600 6910	diode, FD841	FCI	
CR8419	2600 8020	diode, FDG3091	FCI	
CR8420 to CR8424	2600 6910	diode, FD841	FCI	
CR8701	2600 9680	diode, 1N4174B	GI	
CR8702	2600 6820	diode, FD281	FCI	
CR8703	2600 6910	diode, FD841	FCI	
CR8704	2600 6820	diode, FD281	FCI	
CR8705 to CR8707	2600 6910	diode, FD841	PCI	
CR8801 to CR8805	2600 6910	diode, FD841	PCI	
CR8806 to CR8808	2600 6910	diode, FD841	PCI	

LAMPS

DS8401	(Part of S840)	light (REARM)		
DS8601	1200 3960	glow, neon, NE-2 (UNCAL)	GE	NE-2

HYBRID COILS & RF COILS

HY8201	2110 1560	bead, ferroxcube	FER	
HY8501 to HY8505	2110 1560	bead, ferroxcube	FER	
L8101	2110 1350	RF, 3.3 UH, J	SSW	D10647
L8201	2110 1350	RF, 3.3 UH, J	SSW	D10647
L8301	2110 1350	RF, 3.3 UH, J	SSW	D10647

ELECTRICAL CONNECTORS

J8100	0905 7610	receptacle, RF, BNC, female, 1 contact (EXT TRIG)	UG 625A/U	
J8201	0905 9410	receptacle, RF, 1 contact, BSM (+ GATE)	AUT	RF 0740
J8301	0905 7610	receptacle, RF, female, BNC 1 contact (EXT TRIG X AMPL)	UG 625A/U	
J8401	0905 9410	receptacle, RF, BSM, 1 contact (+ GATE)	AUT	RF 0740
J8402	0905 9410	receptacle, RF, BSM, 1 contact (+ SAW)	AUT	RF 0740
J8403	0905 9410	receptacle, RF, BSM, 1 contact (EXT REARM)	AUT	RF 0740
P8001	0905 7340	plug, GP, male, 32 contacts	APH	26 159 32
--------	0905 9830	adapter, BSM 2 BNC	AUT	RF 0756

TRANSISTORS

Q8101 & Q8102	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8103 to Q8106	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q8201 & Q8202	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8203	2600 7260	DU # 6	FCI	
	2600 7250	alternate, 2N1893		
Q8204 to Q8206	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8207	2600 7260	DU # 6	FCI	
	2600 7250	alternate, 2N1893		
Q8208	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8209	2600 7260	DU # 6	FCI	
	2600 7250	alternate, 2N1893		
Q8301 & Q8302	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8303 to Q8305	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8306	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8401	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8402	2631 2210	2N3723	FCI	
Q8403 & Q8404	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8405	2600 7260	DU # 6	FCI	
	2600 7250	alternate, 2N1893		
Q8406 & Q8407	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8408	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8409 &		DU # 6	FCI	
Q8410	2600 7260	DU # 6		
	2600 7250	alternate, 2N1893		
Q8501 to Q8503	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8504	2600 7260	DU # 6	FCI	
	2600 7250	alternate, 2N1893		
Q8505 & Q8506	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8507	2600 3061	selected	FCI	
	2600 8640	alternate, DU # 36A		
Q8508 & Q8509	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8510 & Q8511	2600 8640	DU # 36A	FCI	
	2600 8620	alternate, 2N3114		
Q8601	2600 7170	DU # 4A	FCI	
	2600 7150	alternate, 2N1132		
Q8602	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8603	2600 7170	DU # 4A	FCI	
	2600 7150	alternate, 2N1132		
Q8701	2600 8630	DU # 36	FCI	
	2600 8620	alternate, 2N3114		
Q8702 & Q8703	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8704	2600 8630	DU # 36	FCI	
	2600 8620	alternate, 2N3114		
Q8705	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8801	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8802	2600 7420	DU # 9A	FCI	
	2600 7400	alternate, 2N869		
Q8803	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8804 & Q8805	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8806 & Q8807	2600 8170	2N2369	PCI	
	2600 8190	alternate, DU # 14A		
Q8808	2600 7170	DU # 4A	FCI	
	2600 7150	alternate, 2N1132		
Q8809 & Q8810	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8811 & Q8812	2600 8170	2N2369	FCI	
	2600 8190	alternate, DU # 14A		
Q8813	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		
Q8814 & Q8815	2600 7070	DU # 2A	FCI	
	2600 7050	alternate, 2N915		

RESISTORS

Note: All resistors are fixed, film, ±5%, ½W, and values are in ohms unless otherwise specified; K = thousand, M = million.

			Code	Type
R8101	0203 1190	composition, 910K	ALB	EB
R8102	0234 8700	110K	CGW	C20
R8103	0234 8450	10K	CGW	C20
R8104	0234 7970	100	CGW	C20
R8105	0235 5130	composition, 150K, ¼W	ALB	CB
R8106	0107 2399	variable, composition, 50K, ±20% (LEVEL)	FI	
R8107	0234 8530	22K	CGW	C20
R8108	0234 8270	1.8K	CGW	C20
R8109	0234 8690	100K	CGW	C20
R8111	0203 1200	composition, 1M	ALB	EB
R8112	0234 8690	100K	CGW	C20
R8113	0234 8000	130	CGW	C20
R8114	0203 0160	composition, 47	ALB	EB
R8116	0234 8490	15K	CGW	C20
R8117	0203 0160	composition, 47	ALB	EB
R8118 & R8119	0234 7970	100	CGW	C20
R8121	0203 0160	composition, 47	ALB	EB
R8122	0235 0780	8.2K, ±2%	CGW	C20
R8123	0236 6480	6.81K, ±1%	CGW	NS20
R8124	0203 0110	composition, 30	ALB	EB
R8125	0234 8090	330	CGW	C20
R8126	0109 3570	variable, composition, 100, .1W (TRIG SENS B)	CRL	601-1
R8127	0203 0110	composition, 30	ALB	EB
R8128	0234 8490	15K	CGW	C20
R8129	0234 8470	12K	CGW	C20
R8131	0234 8210	1K	CGW	C20
R8132	0234 8730	150K	CGW	C20
R8133	0234 8560	30K	CGW	C20
R8134	0203 1130	composition, 510K	ALB	EB
R8136	0234 8350	3.9K	CGW	C20
R8138	0235 0890	24K, ±2%	CGW	C20
R8139	0234 8300	2.4K	CGW	C20
R8141	0236 7130	32.4K, ±1%	CGW	NS20
R8142	0236 3090	200K	CGW	C20
R8143	0234 8520	20K	CGW	C20
R8201	0234 8370	4.7K	CGW	C20
R8202	0234 8310	2.7K	CGW	C20
R8203	0234 9220	5.1K, 1W	CGW	C32
R8204	0235 0410	240, ±2%	CGW	C20
R8206	0236 5660	953, ±1%	CGW	NS20
R8207	0234 8440	9.1K	CGW	C20
R8208	0234 8600	43K	CGW	C20
R8209	0234 8030	180	CGW	C20
R8211	0237 8310	750, 1W	CGW	C6
R8212	0203 1170	composition, 750K	ALB	EB
R8213	0234 8690	100K	CGW	C20
R8214	0234 8450	10K	CGW	C20
R8216	0234 8480	13K	CGW	C20
R8217	0234 8590	39K	CGW	C20
R8218	0234 7970	100	CGW	C20
R8219	0236 3130	300K	CGW	C20
R8222	0235 0560	1K, ±2%	CGW	C20
R8223	0235 0640	2.2K, ±2%	CGW	C20

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8224	0235 0890	24K, ±2%	CGW	C20
R8226	0234 8450	10K	CGW	C20
R8227	0234 7970	100	CGW	C20
R8228	0234 8270	1.8K	CGW	C20
R8229	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	70
R8231	0234 9220	5.1K, 1W	CGW	C32
R8233	0234 8320	3K	CGW	C20
R8237	0234 8040	200	CGW	C20
R8238	0237 1210	39K, 2W	CGW	C42S
R8239	0109 0700	variable, composition, 100, ±20% (SWP RATE BAL)	CTS	65
R8241	0234 7970	100	CGW	C20
R8242	0235 0850	16K, ±2%	CGW	C20
R8243	0234 7970	100	CGW	C20
R8244	0234 8040	200	CGW	C20
R8246	0234 7970	100	CGW	C20
R8247	0234 8280	2K	CGW	C20
R8248	0235 0930	36K, ±2%	CGW	C20
R8250	0236 3110	240K	CGW	C20
R8251	0234 8690	100K	CGW	C20
R8252	0203 0160	composition, 47	ALB	EB
R8253	0234 7970	100	CGW	C20
R8254	0203 0110	composition, 30	ALB	EB
R8256	0234 8380	5.1K	CGW	C20
R8257	0234 8040	200	CGW	C20
R8258	0234 8530	22K	CGW	C20
R8259	0234 8500	16K	CGW	C20
R8261	0234 8380	5.1K	CGW	C20
R8262	0234 7970	100	CGW	C20
R8263	0234 8690	100K	CGW	C20
R8264	0203 1200	composition, 1M	ALB	EB
R8266	0234 9240	6.2K, 1W	CGW	C32
R8267	0203 0160	composition, 47	ALB	EB
R8268	0234 8470	12K	CGW	C20
R8269	0234 8490	15K	CGW	C20
R8271	0109 0460	variable, wirewound, 4K, 1½W, ±10% (DELAY CAL ADJ)	CLS	49M
R8272	0234 5150	wirewound, 9.1K, 3W	DAL	CS 2B
R8273	0109 0920	variable, wirewound, 2K, 2W (DELAY TIME MULT)	CLS	62JA
R8274	0109 0810	variable, composition, 250, ±20%, .3W (DELAY ZERO)	CTS	70
R8276	0237 0910	2.2K, 2W	CGW	C42S
R8301	0238 1510	900K, 1W, ±1%	CGW	C6
R8302	0238 1520	111K, 1W, ±1%	CGW	C6
R8303	0234 8450	10K	CGW	C20
R8304F/R	0107 2792	variable, composition, 50K/3K, ±20% (LEVEL/X AMPL VAR)	FI	
R8306	0234 8530	22K	CGW	C20
R8307	0234 8390	5.6K	CGW	C20
R8308	0234 8320	3K	CGW	C5
R8309	0234 8300	2.4K	CGW	C20
R8310	0109 0830	variable, composition, 100K, .2W, ±20% (DC BAL)	CTS	70
R8311	0234 8690	100K	CGW	C20
R8312	0234 8690	100K	CGW	C20
R8313	0203 1200	composition, 1M	ALB	EB
R8314	0234 8000	130	CGW	C20
R8315	0234 8690	100K	CGW	C20
R8316	0203 0160	composition, 47	ALB	EB
R8317	0234 8490	15K	CGW	C20
R8318	0234 8080	300	CGW	C20
R8319	0235 0560	1K, ±2%	CGW	C20
R8320	0235 4250	composition, 30, ¼W, .1W	ALB	CB
R8321	0235 0750	6.2K, ±2%	CGW	C20
R8322	0109 3570	variable, composition, 100 (TRIG SENS)	CRL	601-1
R8323	0236 3170	430K	CGW	C20
R8324	0203 0110	composition, 30	ALB	EB
R8325	0234 8090	330	CGW	C20
R8326 & R8327	0234 7970	100	CGW	C20
R8328	0235 0700	3.9K, ±2%	CGW	C20
R8329	0237 8760	2.21K, 1W, ±1%	CGW	C6
R8331	0234 7970	100	CGW	C20
R8333	0234 8350	3.9K	CGW	C20
R8334	0234 8220	1.1K	CGW	C20
R8336	0234 8220	1.1K	CGW	C20
R8337	0235 0800	10K, ±2%	CGW	C20
R8338	0234 8590	39K	CGW	C20
R8339	0109 0830	variable, composition, 100K, .2W ±20% (X AMPL CENT)	CTS	70
R8341	0235 0760	6.8K, ±2%	CGW	C20
R8342	0235 0760	6.8K, ±2%	CGW	C20
R8343	0236 3110	240K	CGW	C20
R8344	0235 0870	20K, ±2%	CGW	C20
R8346	0235 0870	20K, ±2%	CGW	C20
R8347	0234 8490	15K	CGW	C20
R8348	0234 8470	12K	CGW	C20
R8349	0234 8280	2K	CGW	C20
R8351	0234 8710	120K	CGW	C20
R8352	0234 8560	30K	CGW	C20
R8353	0236 3120	270K	CGW	C20
R8354	0234 8350	3.9K	CGW	C20
R8356	0235 0880	22K, ±2%	CGW	C20
R8357	0234 8300	2.4K	CGW	C20
R8358	0235 0900	27K, ±2%	CGW	C20
R8359	0234 8600	43K	CGW	C20
R8361	0234 8610	47K	CGW	C20
R8362	0234 8110	390	CGW	C20
R8401	0234 8560	30K	CGW	C20
R8402	0234 8510	18K	CGW	C20
R8403	0203 1200	composition, 1M	ALB	EB
R8404	0234 9220	5.1K, 1W	CGW	C32
R8406	0234 8210	1K	CGW	C20
R8407	0237 0840	1.1K, 2W	CGW	C42S
R8408	0234 7950	82	CGW	C20
R8409	0109 0880	variable, composition, 10K, ±20%, .2W (PATT CORR)	CTS	70
R8411	0228 3810	1.5K, 3W	CGW	LPI3
R8412	0234 8010	150	CGW	C20
R8413	0109 0490	variable, composition, 250, ±20%, .3W (BRIGHT ADJ)	CTS	70
R8414	0234 7970	100	CGW	C20
R8416	0234 8530	22K	CGW	C20
R8417	0234 8370	4.7K	CGW	C20
R8418	0234 8350	3.9K	CGW	C20
R8419	0236 3180	470K	CGW	C20
R8420	0234 8320	3K	CGW	C20
R8421	0236 3180	470K	CGW	C20
R8422	0236 5660	953, ±1%	CGW	NS20
R8423	0234 8440	9.1K	CGW	C20
		180	CGW	C20
R8426	0237 8310	750, ±1%, 1W	CGW	C6
R8427	0203 1170	composition, 750K	ALB	EB
R8428	0234 8690	100K	CGW	C20
R8429	0234 8480	13K	CGW	C20
R8431	0234 8590	39K	CGW	C20
R8432	0234 8450	10K	CGW	C20
R8433	0234 8520	20K	CGW	C20
R8434	0235 0560	1K, ±2%	CGW	C20
R8436	0234 8550	27K	CGW	C20
R8437	0234 8170	680	CGW	C20
R8438	0234 8380	5.1K	CGW	C20
R8439	0235 0570	1.1K, ±2%	CGW	C20
R8441	0234 8490	15K	CGW	C20
R8442	0234 8640	62K	CGW	C20
R8443	0234 8450	10K	CGW	C20
R8444	0234 9190	3.9K, 1W	CGW	C32
R8446	0203 1170	composition, 750K	ALB	EB
R8447	0203 1170	composition, 750K	ALB	EB
R8448	0234 8490	15K	CGW	C20
R8449	0235 0570	1.1K, ±2%	CGW	C20
R8451	0234 8040	200	CGW	C20
R8452	0237 1210	39K, 2W	CGW	C42S
R8453	0234 8610	47K	CGW	C20
R8454	0234 8040	200	CGW	C20
R8456	0235 0640	2.2K, ±2%	CGW	C20
R8457	0235 0820	12K, ±2%	CGW	C20
R8458	0234 7970	100	CGW	C20
R8459	0234 8040	200	CGW	C20
R8461	0235 0890	24K, ±2%	CGW	C20
R8462	0235 4380	composition, 100, ¼W	ALB	CB
R8463	0234 8280	2K	CGW	C20

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8464	0235 0930	36K, ±2%	CGW	C20
R8465	0109 0830	variable, composition, 100K, ±20%, .2W (SW DC BAL)	CTS	70
R8466	0236 3110	240K	CGW	C20
R8467	0234 7970	100	CGW	C20
R8468	0235 4720	composition, 3K, ¼W	ALB	CB
R8469	0234 9240	6.2K, 1W	CGW	C20
R8471	0235 4300	composition, 47, ¼W	ALB	CB
R8472	0234 8610	47K	CGW	C20
R8473	0234 8270	1.8K	CGW	C20
R8474	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	70
R8476	0234 9220	5.1K, 1W	CGW	C32
R8477	0204 2300	composition, 91M, ±20%	IRC	GBT½
R8478	0234 8210	1K	CGW	C20
R8479	0235 4850	composition, 10K, ¼W	ALB	CB
R8488	0234 8610	47K	CGW	C20
R8489	0234 8110	390	CGW	C20
R8501	0203 1130	composition, 510K	ALB	EB
R8502	0107 2545	variable, 50K, ±20% (POS)	FI	
R8503	0107 3252	variable, 30K, ±10%, ¾W (PART OF S815)	FI	
R8504	0234 8690	100K	CGW	C20
R8506	0236 3090	200K	CGW	C20
R8507	0228 5110	13.3K, ±1%	IRC	DCC
R8508	0236 3130	300K	CGW	C20
R8509	0234 8000	130	CGW	C20
R8511	0234 8420	7.5K	CGW	C20
R8512	0109 0710	variable, composition, 750, ±10% (X10 REGISTRATION)	CTS	65
R8513	0234 8450	10K	CGW	C20
R8514	0236 5260	365, ±1%	CGW	NS20
R8516	0234 8470	12K	CGW	C20
R8517	0236 4600	75, ±1%	CGW	NS20
R8518	0234 7970	100	CGW	C20
R8519	0236 6660	10.5K, ±1%	CGW	NS20
R8521	0228 5040	1.21K, ±1%	IRC	DCC
R8522	0236 6590	8.87K, ±1%	CGW	NS20
R8523	0236 6590	8.87K, ±1%	CGW	NS20
R8524	0234 8630	56K	CGW	C20
R8526	0203 0160	composition, 47	ALB	EB
R8527	0236 6140	3.01K, ±1%	CGW	NS20
R8528	0236 6060	2.49K, ±1%	CGW	NS20
R8529	0236 5630	887, ±1%	CGW	NS20
R8531	0234 8640	62K	CGW	C20
R8532	0236 6720	12.1K, ±1%	CGW	NS20
R8533	0234 7970	100	CGW	C20
R8534	0234 7970	100	CGW	C20
R8536	0228 5040	1.21K, ±1%	IRC	DCC
R8537 & R8538	0234 9160	2K, 1W	CGW	C32
R8539	0234 8250	1K	CGW	C20
R8541	0235 1760	7.8K, 5W	CGW	LP15
R8542	0235 4260	composition, 33, ¼W	ALB	CB
R8543	0235 4380	composition, 100, ¼W	ALB	CB
R8544	0109 0700	variable, composition, 100, ±20% (X AMP LEVEL)	CTS	65
R8546	0235 4380	composition, 100, ¼W	ALB	CB
R8547	0235 4260	composition, 33, ¼W	ALB	CB
R8548 & R8549	0235 1760	7.8K	CGW	LP15
R8550	0203 0110	composition, 30	ALB	EB
R8551	0235 1750	2.1K, 5W	CGW	LP15
R8552	0235 1750	2.1K, 5W	CGW	LP15
R8553	0235 1760	7.8K	CGW	LP15
R8554	0236 5680	1K, ±1%	CGW	NS20
R8556 & R8557	0235 4310	composition, 51, ¼W	ALB	CB
R8558 & R8559	0230 0760	10K, ±10%, 4W	CGW	DPI4
R8601	0239 0251	18M, ±1%, 1W	FI	
R8602	0239 0241	9M, ±1%	FI	
R8603	0239 0242	5.4M, ±1%	FI	
R8604	0239 9289	1.8M, ±0.5%	FI	
R8606	0239 0287	900K, ±0.5%	FI	
R8607	0239 0286	500K, ±0.5%	FI	
R8608	0239 0292	4M, ±0.5%	FI	
R8609	0239 0291	2M, ±0.5%	FI	

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8611	0239 0288	1.2M, ±0.5%	FI	
R8612	0239 0285	400K, ±0.5%	FI	
R8613	0239 0284	200K, ±0.5%	FI	
R8614	0239 0283	120K, ±0.5%	FI	
R8616	0239 0282	40K, ±0.5%	FI	
R8617	0239 0281	20K, ±0.5%	FI	
R8618	0239 0281	20K, ±0.5%	FI	
R8619	0234 8690	100K	CGW	C20
R8620	0107 3261	variable, composition, 5K, ±20%, ¾W (B VERNIER)	FI	
R8621	0235 4380	composition, 100, ¼W	ALB	CB
R8622	0234 8550	27K	CGW	C20
R8623	0107 3051	variable, 10K/2.5K, 5W (SWP CAL)	FI	
R8624	0107 3271	variable, composition, 5K, ±20%, ¾W (A VERNIER)	FI	
R8625	0234 7970	100	CGW	C20
R8626	0234 8230	1.2K	CGW	C20
R8627	0236 3090	200K	CGW	C20
R8628	0234 8380	5.1K	CGW	C20
R8629	0234 8690	100K	CGW	C20
R8631	0239 0251	18M, ±1%, 1W	FI	
R8632	0239 0241	9M, ±1%	FI	
R8633	0239 0242	5.4M, ±1%	FI	
R8634	0239 0289	1.8M, ±0.5%	FI	
R8636	0239 0287	900K, ±0.5%	FI	
R8637	0239 0292	4M, ±0.5%	FI	
R8638	0239 0291	2M, ±0.5%	FI	
R8639	0239 0288	1.2M, ±0.5%	FI	
R8641	0239 0285	400K, ±0.5%	FI	
R8642	0239 0284	200K, ±0.5%	FI	
R8643	0239 0283	120K, ±0.5%	FI	
R8644	0239 0282	40K, ±0.5%	FI	
R8646	0239 0281	20K, ±0.5%	FI	
R8647	0239 0281	20K, ±0.5%	FI	
R8648	0239 0286	500K, ±0.5%	FI	
R8701	0234 8410	6.8K	CGW	C20
R8702	0236 3150	360K	CGW	C20
R8703	0234 8410	6.8K	CGW	C20
R8704	0236 3150	360K	CGW	C20
R8706	0234 7970	100	CGW	C20
R8707	0234 8540	24K	CGW	C20
R8708	0235 0760	6.8K, ±2%	CGW	C20
R8709	0235 0680	3.3K, ±2%	CGW	C20
R8711	0203 0110	composition, 30	ALB	EB
R8712	0234 8040	200	CGW	C20
R8713	0234 0950	wirewound, 6K, 5W	WDL	5X
R8714	0234 8130	470	CGW	C20
R8715	0236 5390	499, ±1%	CGW	NS20
R8716	0234 8660	75K	CGW	C20
R8717	0234 7970	100	CGW	C20
R8718	0234 8520	20K	CGW	C20
R8719	0234 8690	100K	CGW	C20
R8721	0234 7970	100	CGW	C20
R8722	0234 8300	2.4K	CGW	C20
R8723	0234 8080	300	CGW	C20
R8724	0203 0100	composition, 27	ALB	EB
R8726	0234 8280	2K	CGW	C20
R8727	0234 8300	2.4K	CGW	C20
R8728	0234 8540	24K	CGW	C20
R8729	0234 8450	10K	CGW	C20
R8731	0234 8360	4.3K	CGW	C20
R8732	0234 8540	24K	CGW	C20
R8733	0234 8300	2.4K	CGW	C20
R8734	0234 8690	100K	CGW	C20
R8736	0237 0740	430, 2W	CGW	C42S
R8737	0237 0740	430, 2W	CGW	C42S
R8738	0234 8260	1.6K	CGW	C20
R8739	0203 0000	composition, 10	ALB	EB
R8801	0234 8690	100K	CGW	C20
R8802	0234 7970	100	CGW	C20
R8803	0234 8520	20K	CGW	C20
R8804	0234 8450	10K	CGW	C20
R8806	0234 8360	4.3K	CGW	C20
R8807	0234 8450	10K	CGW	C20
R8808	0234 8690	100K	CGW	C20
R8809	0234 8610	47K	CGW	C20
R8811	0234 8300	2.4K	CGW	C20

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8812	0234 8540	24K	CGW	C20
R8813	0234 8410	6.8K	CGW	C20
R8814	0234 8490	15K	CGW	C20
R8816	0234 8370	4.7K	CGW	C20
R8817	0234 7970	100	CGW	C20
R8818	0234 8690	100K	CGW	C20
R8819	0234 8450	10K	CGW	C20
R8821	0234 8670	82K	CGW	C20
R8822	0234 8560	30K	CGW	C20
R8823	0234 8690	100K	CGW	C20
R8824	0234 7970	100	CGW	C20
R8826	0234 8680	91K	CGW	C20
R8827	0234 8630	56K	CGW	C20
R8828	0235 0900	27K, ±2%	CGW	C20
R8829	0203 0000	composition, 10	ALB	EB
R8831	0234 9170	3.3K, 1W	CGW	C32
R8832	0234 8450	10K	CGW	C20
R8833	0234 8590	39K	CGW	C20
R8834	0234 8690	100K	CGW	C20
R8836	0234 8510	18K	CGW	C20
R8837	0236 6160	3.16K, ±1%	CGW	NS20
R8838	0234 8180	750	CGW	C20
R8839	0234 9170	3.3K, 1W	CGW	C32
R8841	0234 8450	10K	CGW	C20
R8842	0234 8510	18K	CGW	C20
R8843	0234 8590	39K	CGW	C20
R8844	0234 8690	100K	CGW	C20
R8845	0234 8450	10K	CGW	C20
R8846	0234 8250	1.5K	CGW	C20
R8847	0234 8340	3.6K	CGW	C20
R8861	0234 8690	100K	CGW	C20
R8862	0203 1200	composition, 1M	ALB	EB
R8863	0234 8560	30K	CGW	C20
R8864	0234 8610	47K	CGW	C20
R8866	0234 8610	47K	CGW	C20
R8867	0235 0900	27K, ±2%	CGW	C20
R8868	0235 0900	27K, ±2%	CGW	C20
R8869	0234 7970	100	CGW	C20
R8871	0236 3180	470K	CGW	C20
R8872	0234 7970	100	CGW	C20
R8873	0234 8690	100K	CGW	C20
R8874	0203 1200	composition, 1M	ALB	EB
R8876	0234 7970	100	CGW	C20
R8877	0234 8680	91K	CGW	C20
R8878	0234 8630	56K	CGW	C20
R8879	0234 7970	100	CGW	C20
R8881	0234 8680	91K	CGW	C20
R8882	0234 8630	56K	CGW	C20
R8883	0234 8620	51K	CGW	C20
R8884	0234 8450	10K	CGW	C20
R8886	0234 8210	1K	CGW	C20
R8887	0234 8490	15K	CGW	C20
R8888	0234 8340	3.6K	CGW	C20
R8889	0106 7810	variable, composition, 10K, ±20%, .3W (Y TRACE SEPARATION)	CTS	70

SWITCHES

Symbol	Part Number	Description	Recommended Vendor Code	Type
S810	Part of R8106	PULL EXT/10		SSS5
S811	0503 2570	slide, DP3T (SOURCE)	STC	SS54
S812	0503 2570	slide, DP3T (COUPLING)	STC	SS54
S813	0503 2580	slide, DPDT (SLOPE)	STC	SS50
S814	0503 2700	toggle, DPDT, 3P (AUTO TRIG)	ALCO	MST 205 P
S815	0501 7951	rotary, 6 SEC, 12 POS (HORIZ DISPLAY)	FI	
S830	Part of R8304	PULL EXT/10		
S831	0503 2570	slide, DP3T (SOURCE)	STC	SS54
S832	0503 2570	slide, DP3T (COUPLING)	STC	SS54
S833	0503 2580	slide, DPDT (SLOPE)	STC	SS50
S840	0503 2620	push, SPST (REARM)	GRY	40-1
S850	Part of R8502	PULL X10		
S860	0501 7961	RPT, 10 SEC, 25 POS (TIME/DIV)	FI	
S862	Part of R8624			
S863	Part of S860			

TRANSFORMERS

Symbol	Part Number	Description	Recommended Vendor Code	Type
T8101	2001 3742	pulse	FI	
T8201	2001 3742	pulse	FI	
T8301	2001 3742	pulse	FI	

ELECTRON TUBES

Symbol	Part Number	Description	Recommended Vendor Code	Type
V810	2501 3390	6CW4	RCA	NUVISTOR
V820	2501 3400	7895	RCA	NUVISTOR
V830	2501 3390	6CW4	RCA	NUVISTOR
V840	2501 3400	7895	RCA	NUVISTOR

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
AUT	Automatic Metal Products Corporation
BEL	Belfuse
BNS	Bourns Inc.
BUR	Burndy Engrg. Company
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon
COM	Comar Electric
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
CUR	Curtis Inst.
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EDL	Edal Industries
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FAST	John E. Fast Company
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
FTN	Filtron Co. Inc.
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GEN	General Instrument Corporation
GEP	General Products Corporation
GLB	Globe Industries
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HAM	The Hammarlund Manufacturing Co., Inc.
HOF	Hoffman
HON	Honeywell
HOP	Hopkins Engineering Company
HP	Hewlett-Packard Company

CODE	NAME
IDI	Industrial Device
IEC	International Electronics Corporation
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LED	Ledex Inc.
LEE	Leecraft Mfg. Company
LFI	Littlefuse, Inc.
LIN	Line Electric
MAL	P. R. Mallory & Company, Inc.
MCR	Micro Switch (Division of Minneapolis-Honeywell Regulator Co.)
MCT	Microtran
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOT	Motorola Semiconductor Products, Inc.
MOV	M-O Valve Company Ltd.
MSW	Micro Switch
MUC	Mucon Corporation
MUL	Mull Holland
MUT	The Muter Company
NSW	Milli Switch
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SIL	Silicon Transistor Corporation
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWT	Switchcraft
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TNS	Transiton Corp.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
UID	United International Dynamic Corp.
UTC	United Transformer Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

The Instrumentation Division warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Fairchild, the Instrument is determined to be defective in workmanship or material, Fairchild will, subject to the conditions set forth below, either repair the defective part, or replace it with a new part. Fairchild shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Fairchild be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Fairchild service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Fairchild's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Fairchild or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

Fairchild Camera and Instrument Corp.
Instrumentation Division
50 Somerset Place, Clifton, New Jersey

The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

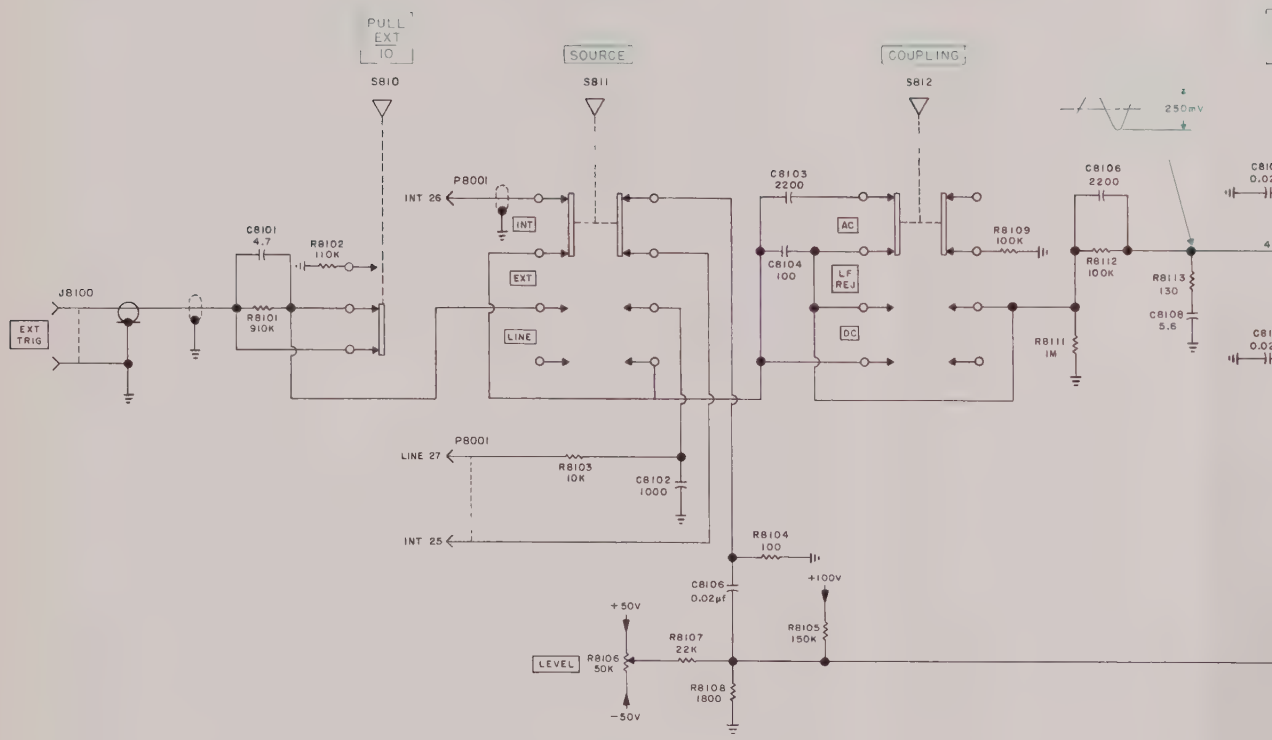
REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Fairchild part number for all electrical components used in the Instrument. This will help to expedite service.

PATENT NOTICE

Manufactured under one or more U. S. Patents owned or controlled by Fairchild Camera and Instrument Corporation. 50 Somerset Place, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.

IMPORTANT! FILL OUT AND MAIL THIS CARD
WARRANTY REGISTRATION
NO STAMP REQUIRED
MAIL FOR MAINTENANCE BULLETINS TO
VOID UNLESS MAILED WITHIN 30 DAYS AFTER RECEIPT
SEE INSTRUCTION MANUAL FOR WARRANTY NOTICE



VOLTAGE DATA

All voltage measurements were obtained with a 20,000 ohms/volt VOM, all readings may vary ± 10%.

2. Preset front panel controls as follows:

Control	Setting
HORIZONTAL DISPLAY	ARMED ALT
TIME/DIV B	.2C m SEC/DIV
TIME/DIV A	5 μSEC/DIV

3. Voltage tolerance ± 15% with respect to ground.

WAVEFORM DATA

4. Use Type 4290 Series Probe (X101 and 10:1 nc Test 5 pmf.

5. Use Type 7A6H Series Test Oscilloscope, DC to 25 Mc.

6. Waveform amplitude measurements are nominal.

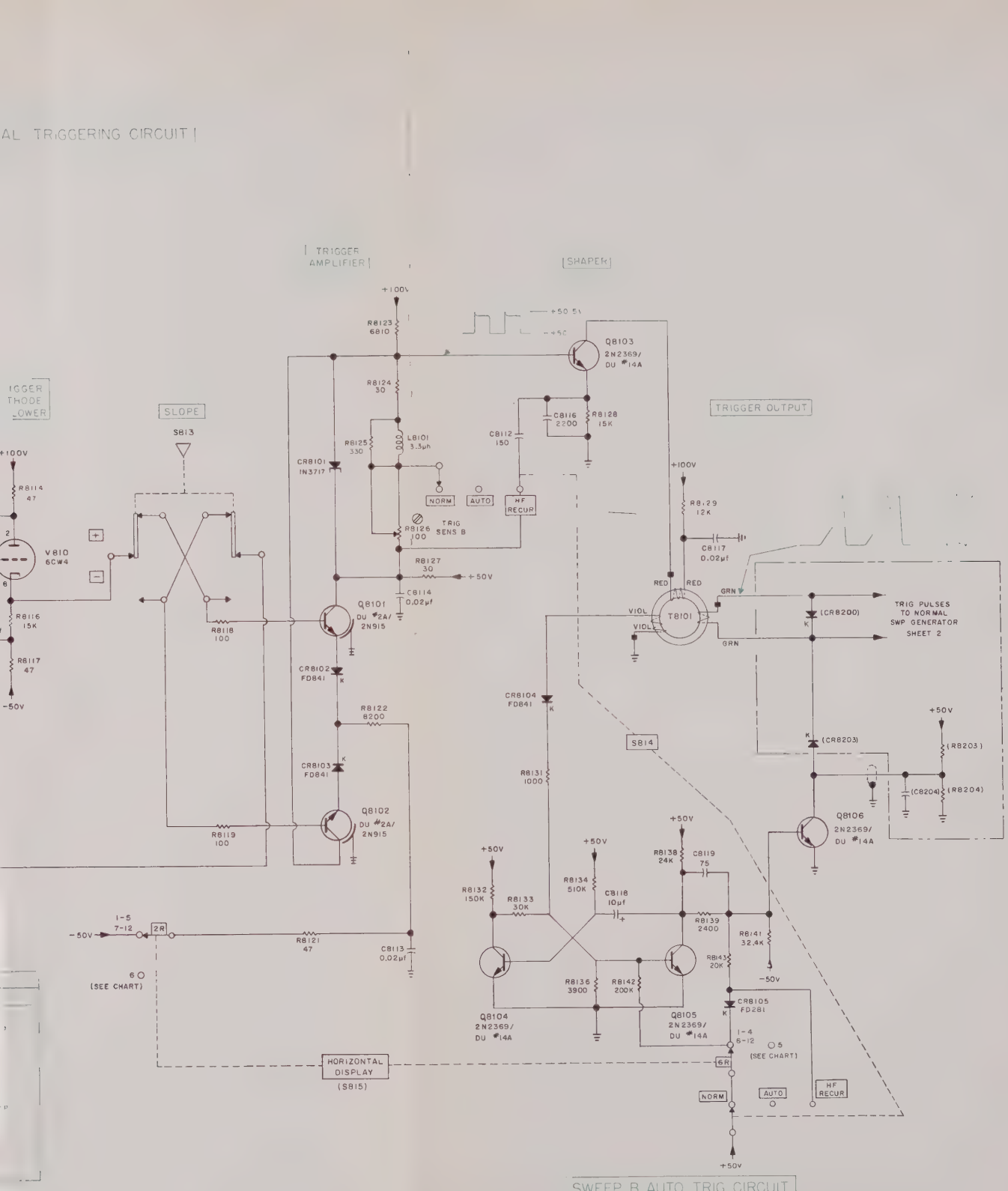
HORIZONTAL DISPLAY CHART

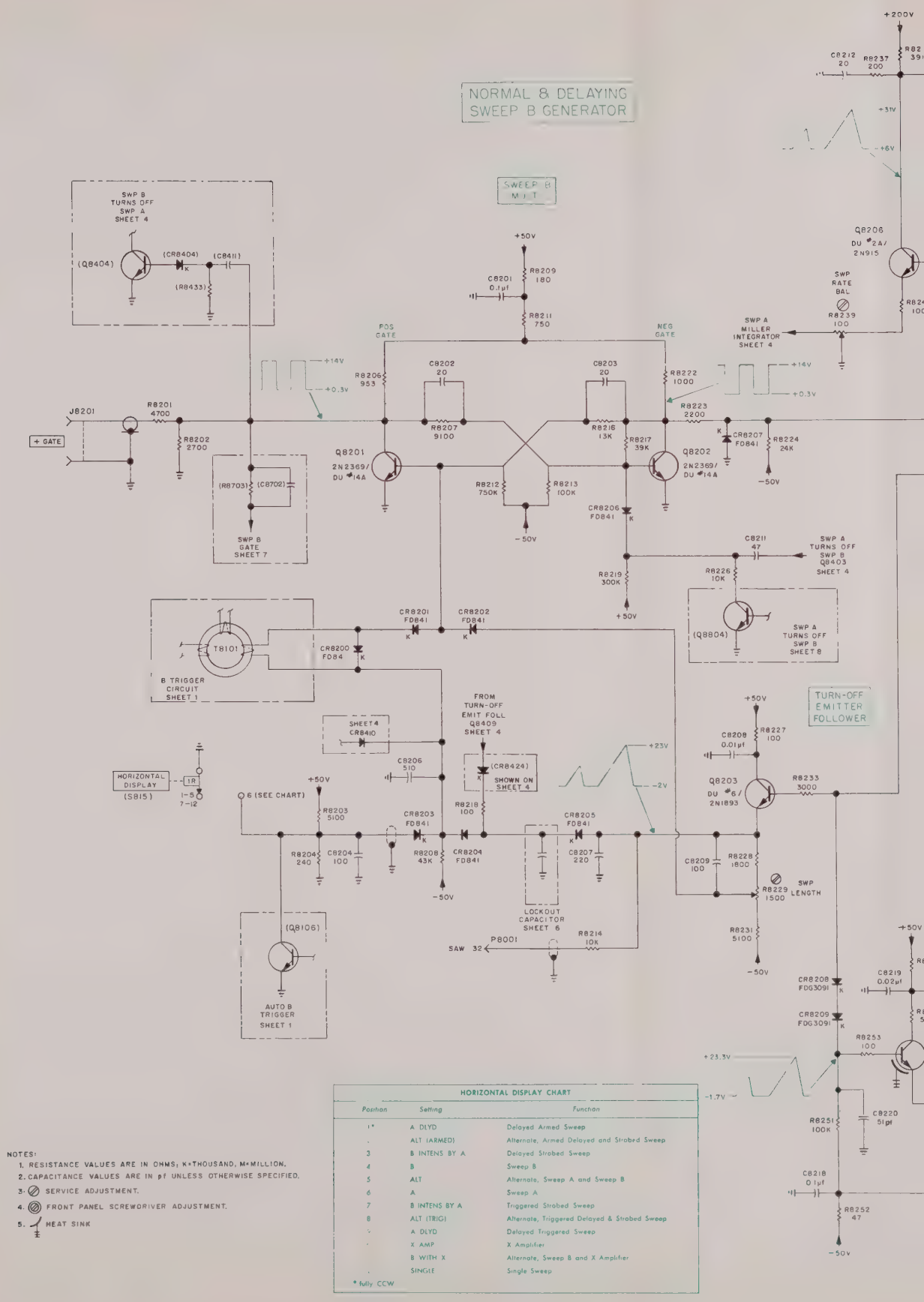
Position	Setting	Function
1*	A DLYD	Delayed Armed Sweep
2	ALT (ARMED)	Alternate, Armed Delayed and Strobed Sw
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
5	ALT	Alternate, Sweep A and Sweep B
6	A	Sweep A
7	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate, Triggered Delayed & Strobed Sw
9	A DLYD	Delayed Triggered Sweep
10	X AMP	X Amplifier
11	B WITH X	Alternate, Sweep B and X Amplifier
12	SINGLE	Single Sweep

* fully CCW

NOTES:

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED
3. ⊘ SERVICE ADJUSTMENT
4. HEAT SINK

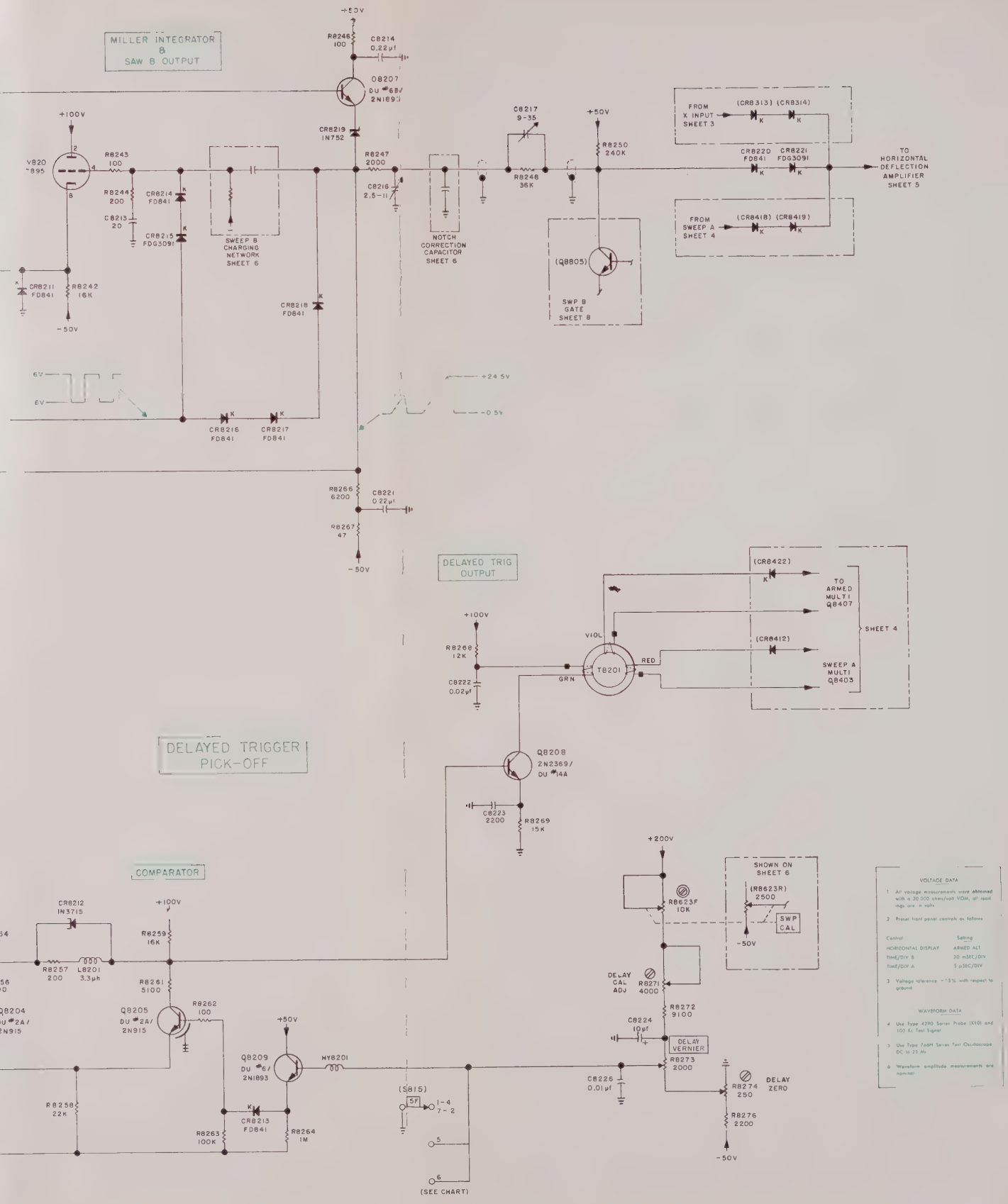

AL TRIGGERING CIRCUIT
TRIGGER AMPLIFIER
SHAPER
SLOPE
S813
TRIGGER OUTPUT
+100V
R8123 6810
Q8103 2N2369/ DU #14A
R8124 30
C8116 2200
R8128 15K
C8112 150
R8125 330
L8101 3.3μh
CR8101 IN3717
NORM
AUTO
HF RECUR
R8126 100 TRIG SENS B
R8127 30
+50V
C8114 0.02μf
Q8101 DU #2A/ 2N915
R8118 100
CR8102 FD841
R8122 8200
CR8103 FD841
Q8102 DU #2A/ 2N915
R8119 100
R8114 47
V810 6CW4
R8116 15K
R8117 47
-50V
R8129 12K
C8117 0.02μf
RED
GRN
VIOL
T8101
(CR8200)
TRIG PULSES TO NORMAL SWP GENERATOR SHEET 2
CR8104 FD841
S814
R8131 1000
(CR8203)
(R8203)
(C8204)
(R8204)
Q8106 2N2369/ DU #14A
R8138 24K
C8119 75
R8134 510K
C8118 10μf
R8132 150K
R8133 30K
R8139 2400
R8141 32.4K
R8143 20K
R8136 3900
R8142 200K
CR8105 FD281
Q8104 2N2369/ DU #14A
Q8105 2N2369/ DU #14A
1-5 7-12
2R
R8121 47
C8113 0.02μf
6 (SEE CHART)
1-4 6-12
5 (SEE CHART)
6R
HORIZONTAL DISPLAY (S815)
SWEEP B AUTO TRIG CIRCUIT



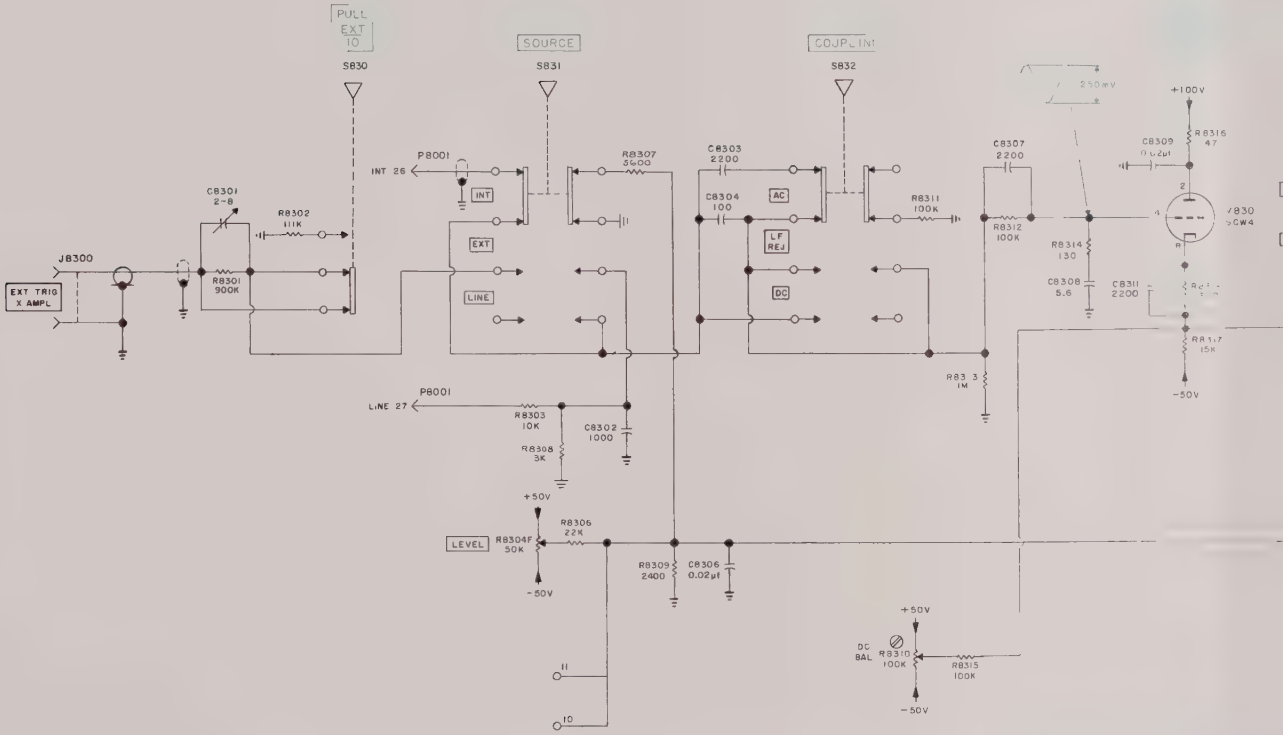
HORIZONTAL DISPLAY CHART		
Position	Setting	Function
1*	A DLYD	Delayed Armed Sweep
.	ALT (ARMED)	Alternate, Armed Delayed and Strobed Sweep
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
5	ALT	Alternate, Sweep A and Sweep B
6	A	Sweep A
7	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate, Triggered Delayed & Strobed Sweep
.	A DLYD	Delayed Triggered Sweep
.	X AMP	X Amplifier
.	B WITH X	Alternate, Sweep B and X Amplifier
.	SINGLE	Single Sweep

* fully CCW

NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
5. HEAT SINK


MILLER INTEGRATOR B SAW B OUTPUT
+50V
R8246 100
C8214 0.22µf
Q8207 DU #6B/ 2N1893
+100V
V820 7895
R8243 100
R8244 200
C8213 20
CR8219 1N752
C8217 9-35
R8248 36K
R8247 2000
C8216 2.5-11
R8250 240K
FROM X INPUT SHEET 3
(CR8313) (CR8314)
CR8220 FD841
CR8221 FDG3091
TO HORIZONTAL DEFLECTION AMPLIFIER SHEET 5
FROM SWEEP A SHEET 4
(CR8418) (CR8419)
CR8214 FD841
CR8215 FDG3091
SWEEP B CHARGING NETWORK SHEET 6
NOTCH CORRECTION CAPACITOR SHEET 6
(Q8805)
SWP B GATE SHEET 8
CR8211 FD841
R8242 16K
-50V
CR8218 FD841
6V
+24.5V
-0.5V
CR8216 FD841
CR8217 FD841
R8266 6200
C8221 0.22µf
R8267 47
DELAYED TRIG OUTPUT
(CR8422)
TO ARMED MULTI Q8407
SHEET 4
(CR8412)
SWEEP A MULTI Q8403
V10L
T8201
RED
GRN
R8268 12K
C8222 0.02µf
DELAYED TRIGGER PICK-OFF
Q8208 2N2369/ DU #4A
C8223 2200
R8269 15K
COMPARATOR
CR8212 1N3715
R8259 16K
R8257 200
L8201 3.3µh
R8261 5100
Q8205 DU #2A/ 2N915
R8262 100
Q8204 DU #2A/ 2N915
Q8209 DU #6/ 2N1893
HY8201
R8258 22K
R8263 100K
CR8213 FD841
R8264 1M
(S815) 5F 1-4 7-2
5
6
(SEE CHART)
+200V
SHOWN ON SHEET 6
(R8623R) 2500
SWP CAL
R8623F 10K
-50V
DELAY CAL ADJ R8271 4000
R8272 9100
C8224 10pf
DELAY VERNIER
R8273 2000
C8226 0.01µf
R8274 250
DELAY ZERO
R8276 2200
-50V
VOLTAGE DATA
1 All voltage measurements were obtained with a 20,000 ohms/volt VOM, all readings are in volts
2 Preset front panel controls as follows
Control Setting
HORIZONTAL DISPLAY ARMED ALT
TIME/DIV B 20 mSEC/DIV
TIME/DIV A 5 µSEC/DIV
3 Voltage tolerance ±15% with respect to ground
WAVEFORM DATA
4 Use Type 4290 Series Probe (X10) and 100 Kc Test Signal
5 Use Type 7904 Series Test Oscilloscope DC to 25 Mc
6 Waveform amplitude measurements are nominal

SWEEP A TRIGGER



NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED
3. ⊘ SERVICE ADJUSTMENT.

VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volt VOM, all readings are in volts
2. Preset front panel controls as follows:

Control	Setting
HORIZONTAL DISPLAY	ARMED ALT
TIME/DIV B	20 mSEC/DIV
TIME/DIV A	5 µSEC/DIV

3. Voltage tolerance ±5% with respect to ground

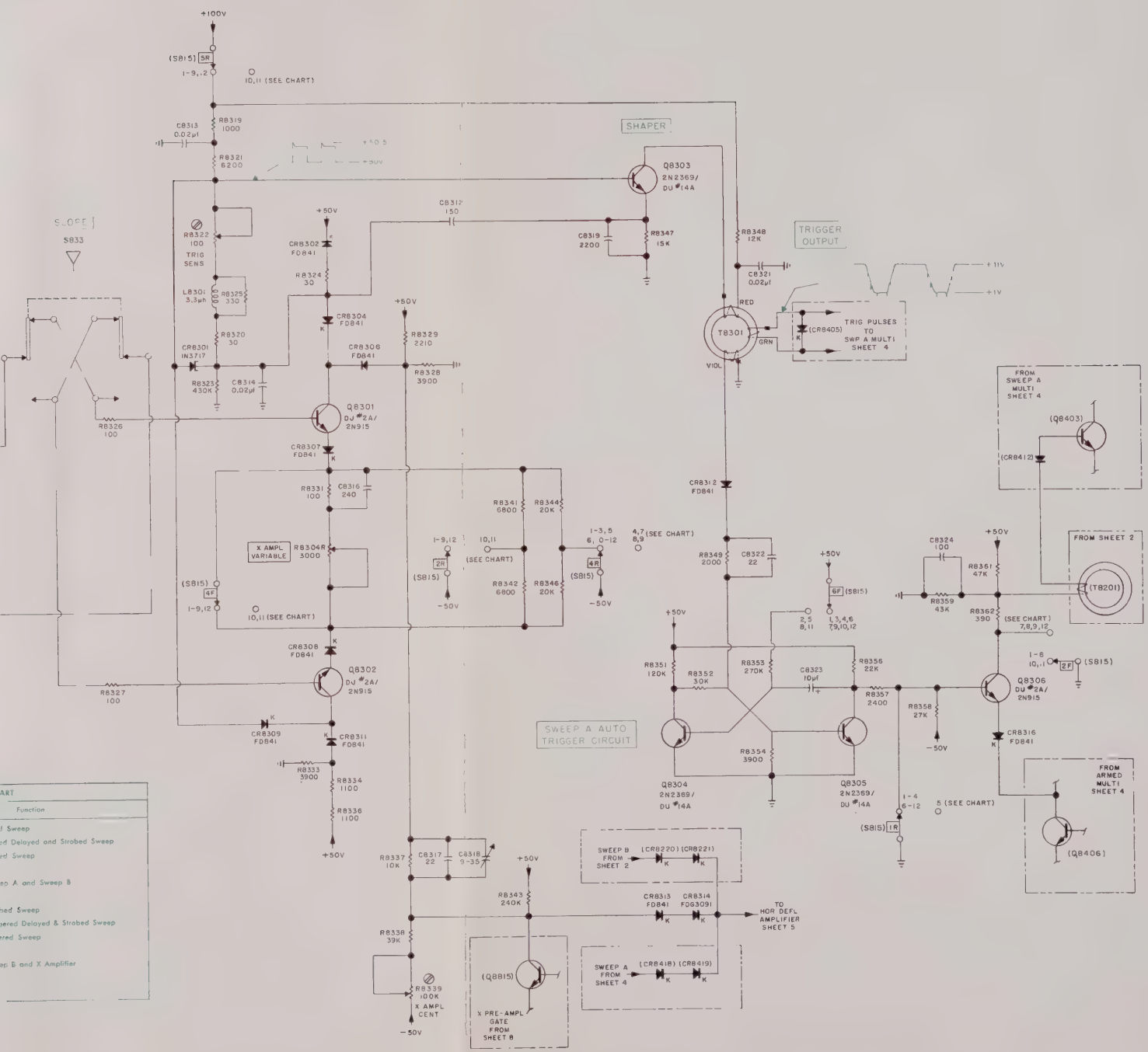
WAVEFORM DATA

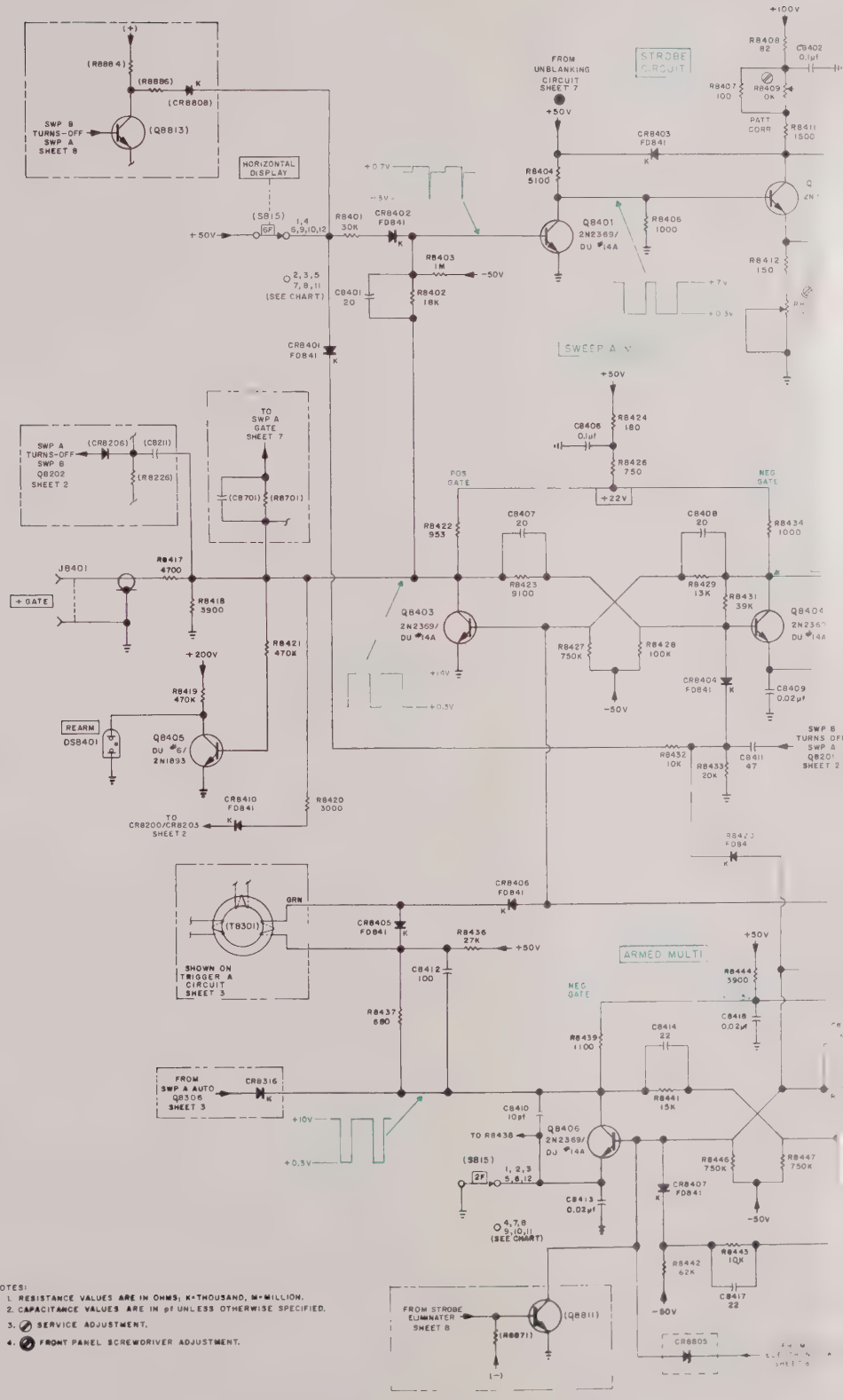
4. Use Type 4290 Series Probe (X10) and 100 Kc Test Signal
5. Use Type 7904 Series Test Oscilloscope, DC to 25 Mc
6. Waveform amplitude measurements are [illegible]

HORIZONTAL DISPLAY

Position	Setting	
1*	A DLYD	Delayed Ar
2	ALT (ARMED)	Alternate, A
3	B INTENS BY A	Delayed Sw
4	B	Sweep B
5	ALT	Alternate, S
6	A	[illegible]
7	B INTENS BY A	[illegible]
8	ALT (TRIG)	Alternate, T
9	A DLYD	Delayed Tri
10	X AMP	X Amplifie
11	B WITH X	Alternate, S
12	SINGLE	Single Swee

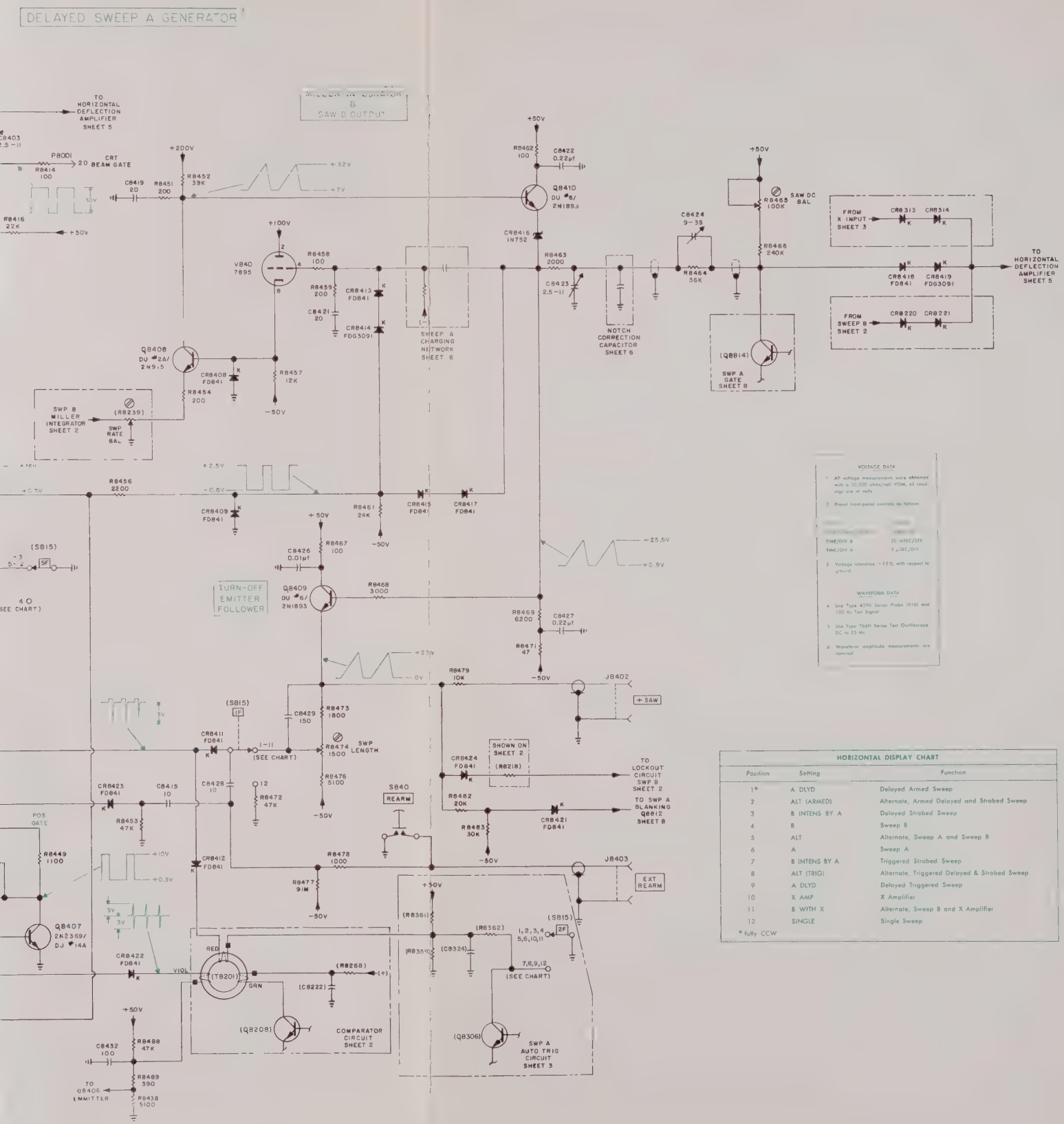
* fully CCW


+100V
(S815) 5R
1-9,12
10,11 (SEE CHART)
C8313 0.02µf
R8319 1000
R8321 6200
+50.5
+50V
SHAPER
Q8303 2N2369/ DU #14A
C8312 150
C8319 2200
R8347 15K
R8348 12K
TRIGGER OUTPUT
C8321 0.02µf
+11V
+1V
SLOPE
S833
R8322 100 TRIG SENS
+50V
CR8302 FD841
R8324 30
L8301 3.3µh
R8325 330
CR8304 FD841
R8320 30
CR8301 IN3717
R8323 430K
C8314 0.02µf
R8329 2210
CR8306 FD841
R8328 3900
Q8301 DU #2A/ 2N915
R8326 100
CR8307 FD841
R8331 100
C8316 240
X AMPL VARIABLE
R8304R 3000
(S815) 4F
1-9,12
10,11 (SEE CHART)
CR8308 FD841
Q8302 DU #2A/ 2N915
R8327 100
CR8309 FD841
CR8311 FD841
R8333 3900
R8334 1100
R8336 1100
+50V
R8337 10K
C8317 22
C8318 9-35
R8338 39K
R8339 100K X AMPL CENT
-50V
R8341 6800
R8344 20K
R8342 6800
R8346 20K
1-9,12
2R
(S815)
-50V
10,11 (SEE CHART)
1-3,5 6, 0-12
4R
(S815)
-50V
4,7 (SEE CHART) 8,9
CR8312 FD841
R8349 2000
C8322 22
+50V
6F (S815)
2,5 8,11
1,3,4,6 7,9,10,12
R8351 120K
R8352 30K
R8353 270K
C8323 10µf
R8356 22K
R8357 2400
R8358 27K
-50V
R8354 3900
Q8304 2N2369/ DU #14A
Q8305 2N2369/ DU #14A
SWEEP A AUTO TRIGGER CIRCUIT
1-4 6-12
5 (SEE CHART)
(S815) 1R
C8324 100
+50V
R8361 47K
R8359 43K
R8362 390
(SEE CHART) 7,8,9,12
FROM SHEET 2
(T8201)
1-6 10,11
2F
(S815)
Q8306 DU #2A/ 2N915
CR8316 FD841
FROM ARMED MULTI SHEET 4
(Q8406)
FROM SWEEP A MULTI SHEET 4
(Q8403)
(CR8412)
T8301
RED
GRN
VIOL
(CR8405)
TRIG PULSES TO SWP A MULTI SHEET 4
SWEEP B FROM SHEET 2
(CR8220) (CR8221)
CR8313 FD841
CR8314 FDG3091
R8343 240K
TO HOR DEFL AMPLIFIER SHEET 5
SWEEP A FROM SHEET 4
(CR8418) (CR8419)
(Q8815)
X PRE-AMPL GATE FROM SHEET 8
Function
Sweep
Delayed and Strobed Sweep
Sweep
A and Sweep B
Sweep
Delayed & Strobed Sweep
Sweep
B and X Amplifier



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volt VOM, all readings are in volts.
2. Preset front-panel controls as follows:

TIME/DIV B	20 mSEC/DIV
TIME/DIV A	5 µSEC/DIV

3. Voltage tolerance ± 15% with respect to ground.

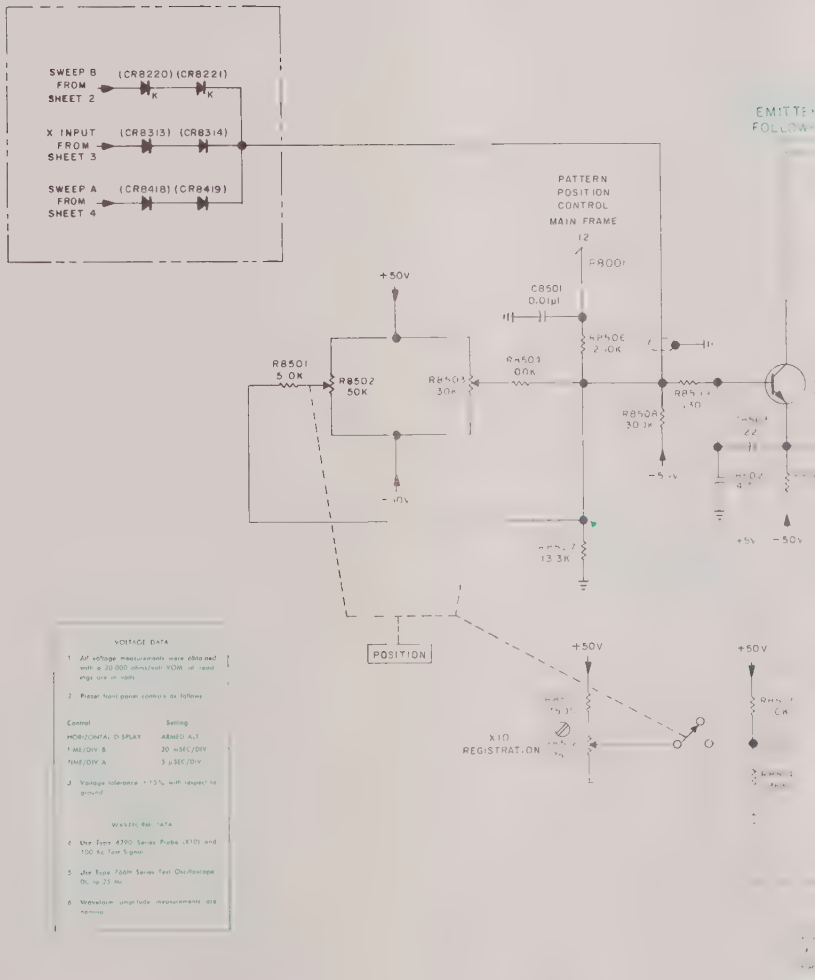
WAVEFORM DATA

4. Use Type 4290 Series Probe (X10) and 100 Kc Test Signal.
5. Use Type 7904 Series Test Oscilloscope DC to 25 Mc.
6. Waveform amplitude measurements are nominal.

HORIZONTAL DISPLAY CHART

Position	Setting	Function
1*	A DLYD	Delayed Armed Sweep
2	ALT (ARMED)	Alternate, Armed Delayed and Strobed Sweep
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
5	ALT	Alternate, Sweep A and Sweep B
6	A	Sweep A
7	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate, Triggered Delayed & Strobed Sweep
9	A DLYD	Delayed Triggered Sweep
10	X AMP	X Amplifier
11	B WITH X	Alternate, Sweep B and X Amplifier
12	SINGLE	Single Sweep

* fully CCW



VOLTAGE DATA

1. All voltage measurements were obtained with a 20,000 ohms/volt VOM. All readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
HORIZONTAL DISPLAY	ARMED A,T
TIME/DIV B	20 mSEC/DIV
TIME/DIV A	5 µSEC/DIV

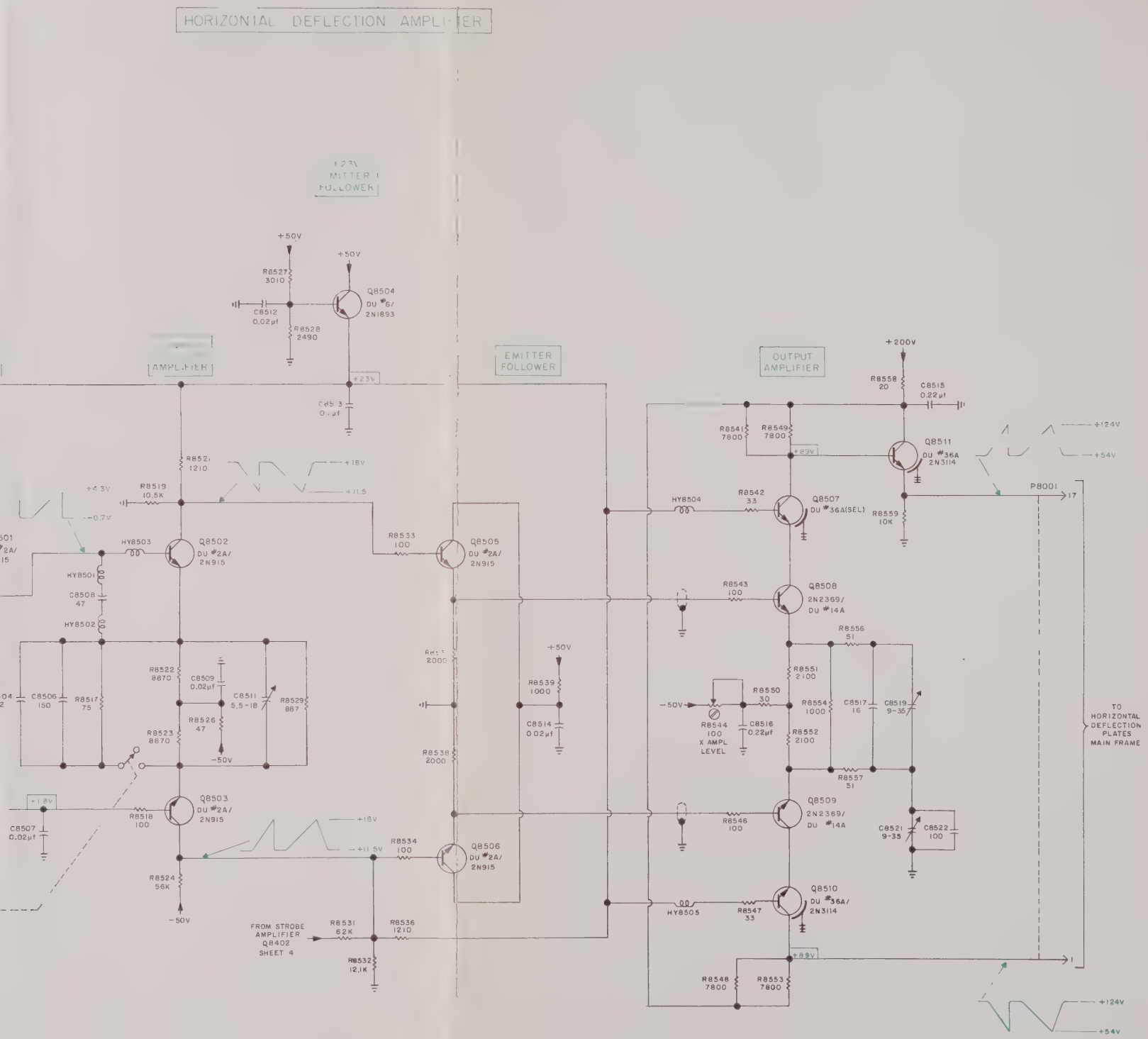
3. Voltage tolerance ±15% with respect to ground.

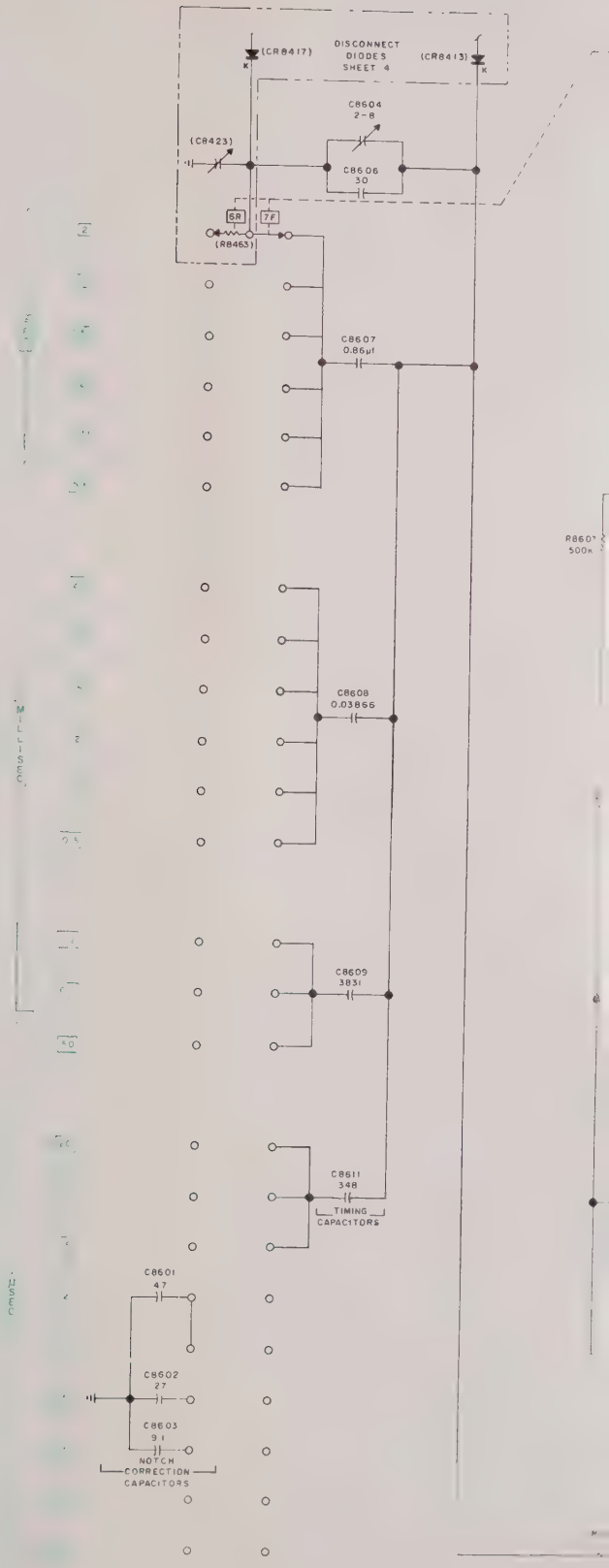
WAVEFORM DATA

4. Use Type 4390 Series Probe (X10) and 100 Ke Test Signal.
5. Use Type 7904 Series Test Oscilloscope or equivalent.
6. Waveform amplitude measurements are nominal.

NOTES:

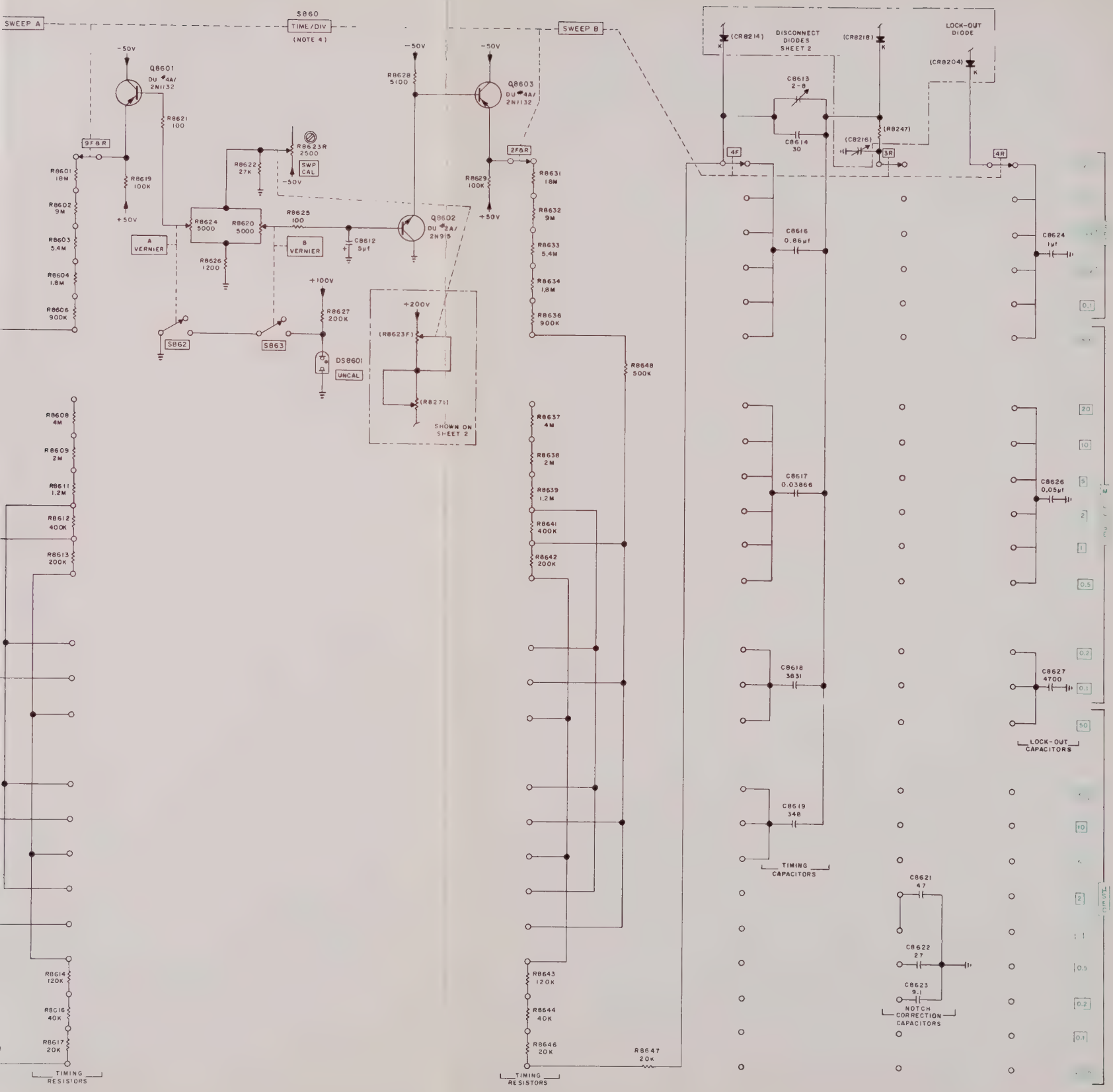
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK.

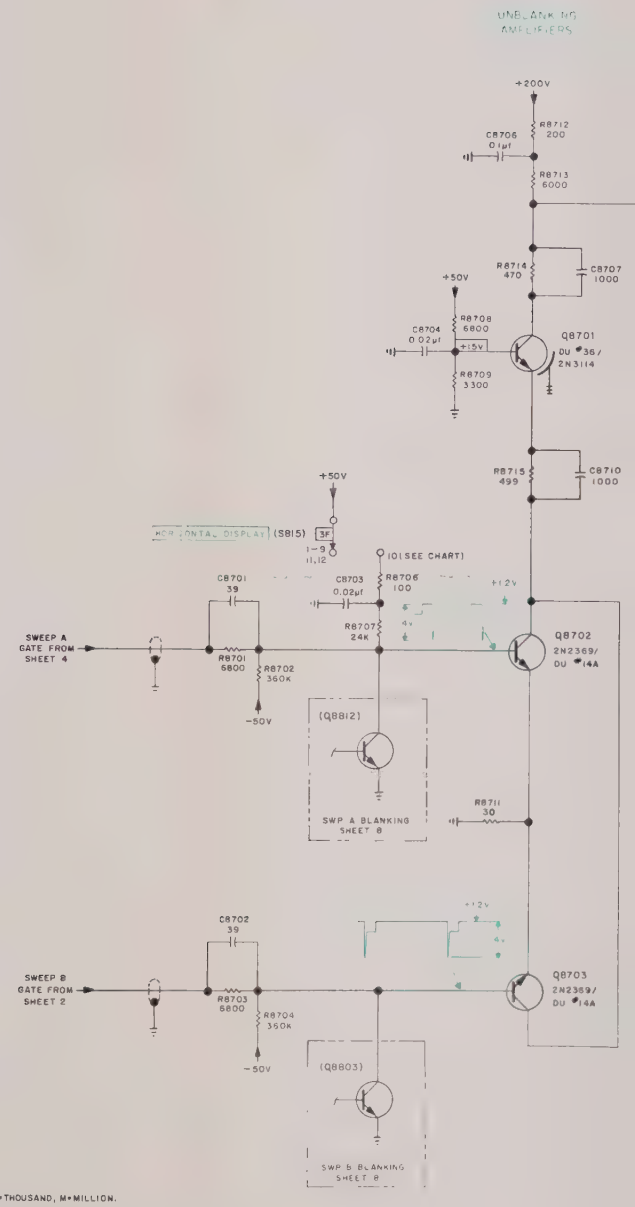

HORIZONTAL DEFLECTION AMPLIFIER
EMITTER FOLLOWER
AMPLIFIER
EMITTER FOLLOWER
OUTPUT AMPLIFIER
+50V
+200V
R8527 3010
C8512 0.02µf
R8528 2490
Q8504 DU #6/ 2N1893
R8558 20
C8515 0.22µf
R8541 7800
R8549 7800
+89V
Q8511 DU #36A 2N3114
+124V
+54V
P8001
17
HY8504
R8542 33
Q8507 DU #36A(SEL)
R8559 10K
R8524 1210
+18V
+11.5
+4.3V
R8519 10.5K
-0.7V
HY8503
Q8502 DU #2A/ 2N915
R8533 100
Q8505 DU #2A/ 2N915
HY8501
C8508 47
HY8502
R8543 100
Q8508 2N2369/ DU #14A
R8556 51
R8551 2100
R8550 30
R8554 1000
C8517 16
C8519 9-35
R8552 2100
R8557 51
R8522 8870
C8509 0.02µf
C8511 5.5-18
R8529 887
R8526 47
R8523 8870
-50V
R8544 100 X AMPL LEVEL
C8516 0.22µf
TO HORIZONTAL DEFLECTION PLATES MAIN FRAME
C8506 150
R8517 75
+50V
R8539 1000
C8514 0.02µf
R8538 2000
+1.8V
R8518 100
Q8503 DU #2A/ 2N915
C8507 0.02µf
+18V
+11.5V
R8534 100
Q8506 DU #2A/ 2N915
R8546 100
Q8509 2N2369/ DU #14A
C8521 9-35
C8522 100
R8524 56K
-50V
Q8510 DU #36A/ 2N3114
HY8505
R8547 33
FROM STROBE AMPLIFIER Q8402 SHEET 4
R8531 62K
R8536 1210
R8532 12.1K
+89V
R8548 7800
R8553 7800
1
+124V
+54V



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ONLY GANGED WHEN SWEEP RATES ARE IDENTICAL.

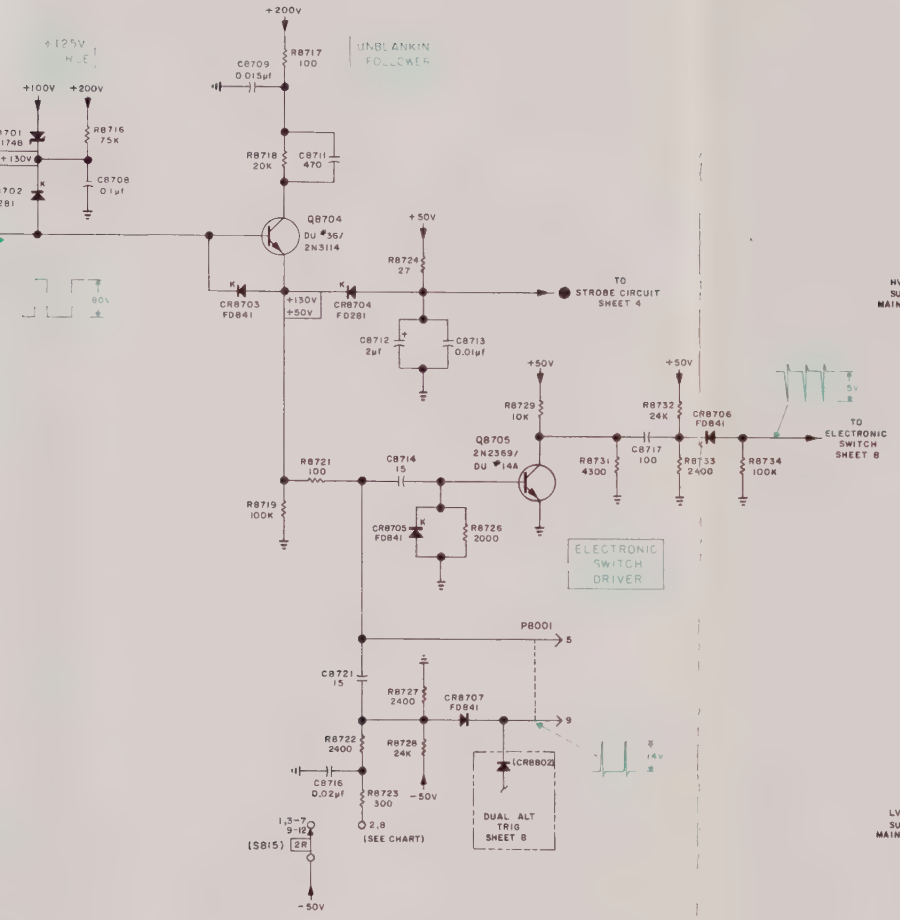

SWEEP A
S860
TIME/DIV
(NOTE 4)
SWEEP B
Q8601
DU 4A/ 2N1132
Q8603
DU 4A/ 2N1132
Q8602
DU 2A/ 2N915
R8601 18M
R8602 9M
R8603 5.4M
R8604 1.8M
R8606 900K
R8608 4M
R8609 2M
R8611 1.2M
R8612 400K
R8613 200K
R8614 120K
R8616 40K
R8617 20K
R8619 100K
R8621 100
R8622 27K
R8623R 2500
SWP CAL
R8624 5000
R8620 5000
R8625 100
R8626 1200
C8612 5µf
A VERNIER
B VERNIER
S862
S863
R8627 200K
DS8601
UNCAL
+100V
+200V
(R8623F)
(R8271)
SHOWN ON SHEET 2
R8628 5100
R8629 100K
R8631 18M
R8632 9M
R8633 5.4M
R8634 1.8M
R8636 900K
R8637 4M
R8638 2M
R8639 1.2M
R8641 400K
R8642 200K
R8643 120K
R8644 40K
R8646 20K
R8647 20K
R8648 500K
TIMING RESISTORS
TIMING RESISTORS
9F 8R
2F 8R
4F
3R
4R
(CR8214)
DISCONNECT DIODES SHEET 2
(CR8218)
LOCK-OUT DIODE
(CR8204)
C8613 2-8
C8614 30
(R8247)
(C8216)
C8616 0.86µf
C8617 0.03866
C8618 383f
C8619 348
TIMING CAPACITORS
C8624 1µf
C8626 0.05µf
C8627 4700
LOCK-OUT CAPACITORS
C8621 47
C8622 27
C8623 9.1
NOTCH CORRECTION CAPACITORS
0.1
20
10
5
2
1
0.5
0.2
0.1
50
10
2
1
0.5
0.2
0.1

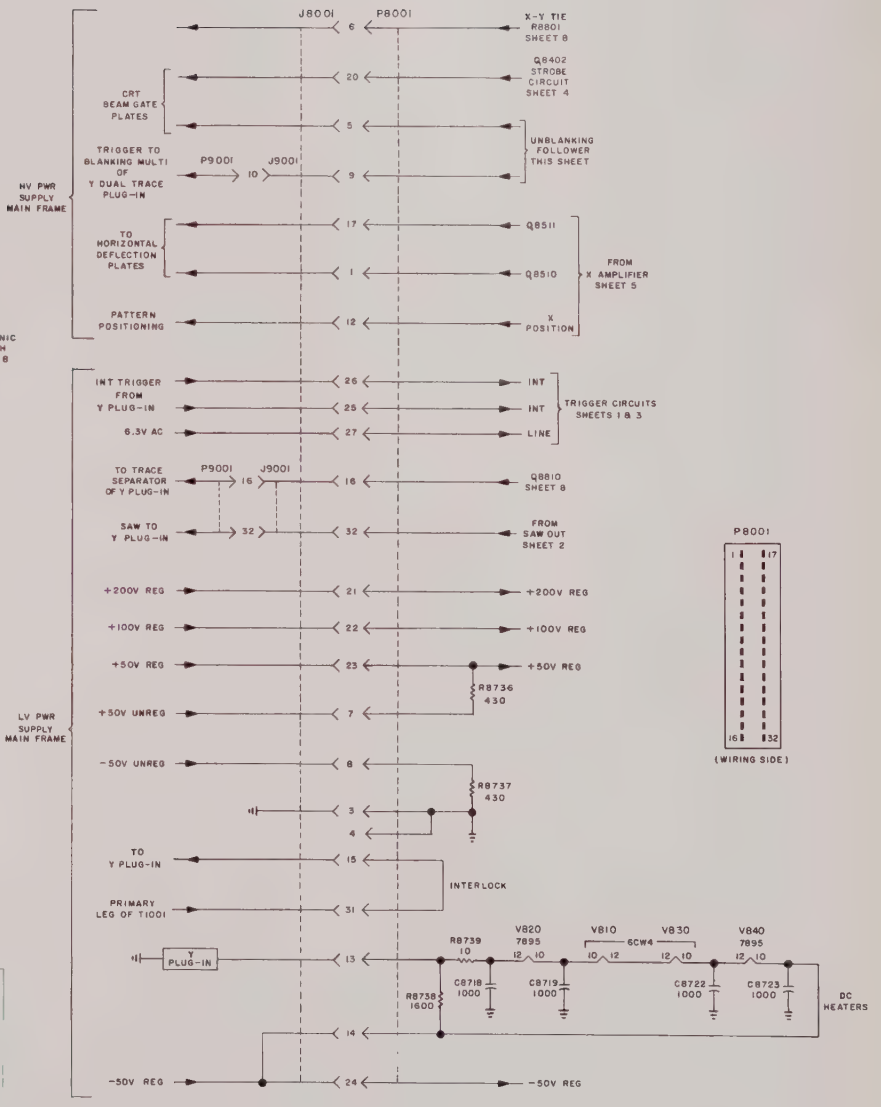


NOTE:

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⏚ HEAT SINK

ANKING CIRCUIT





HORIZONTAL DISPLAY CHART

1*	A DLYD	Delayed Armed Sweep
2	ALT (ARMED)	Alternate Armed Delayed and Strobed Sweep
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
	ALT	Alternate Sweep A and Sweep B
6	A	Sweep A
	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate Triggered Delayed & Strobed Sweep
9	A DLYD	Delayed Triggered Sweep
10	X AMP	X Amplifier
11	B WITH X	Alternate, Sweep B and X Amplifier
12	SINGLE	Single Sweep

* fully CCW

VOLTAGE DATA

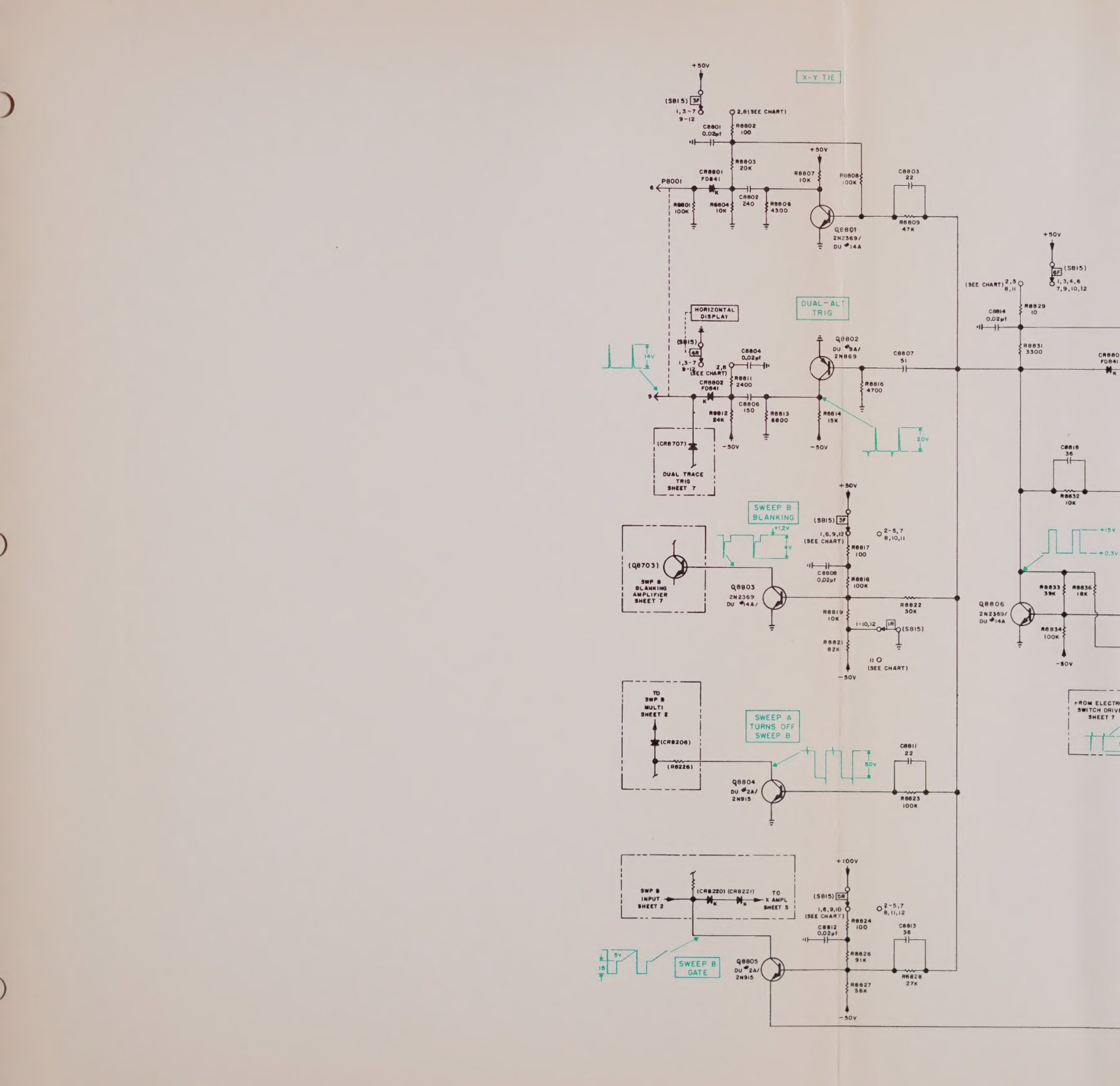
1. All voltage measurements were obtained with a 20,000 ohms/volt VOM at read ing.
2. Preset front panel controls as follows:

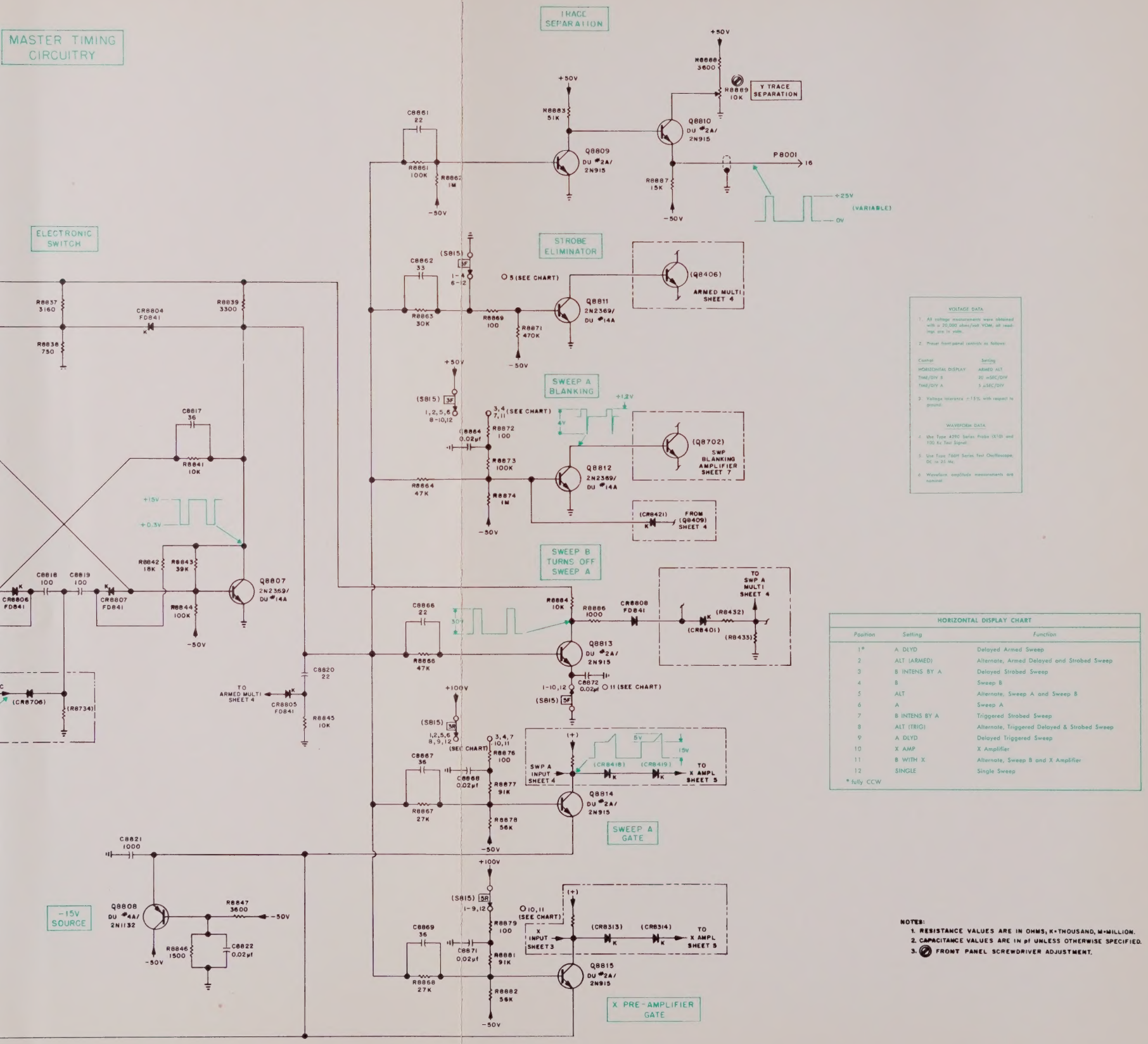
Control	Setting
HORIZONTAL DISPLAY	ARMED ALT
TIME/DIV B	20 mSEC/DIV
TIME/DIV A	5 μSEC/DIV

3. V ground

WAVEFORM DATA

4. Use Tek. 4290 Series Probe (210) and 100 Kc Test
5. Use Type 766M Series Test Oscilloscope DC to 25 M
6. Waveform amplitude measurements are


X-Y TIE
DUAL-ALT TRIG
HORIZONTAL DISPLAY
SWEEP B BLANKING
SWEEP A TURNS OFF SWEEP B
SWEEP B GATE
DUAL TRACE TRIG SHEET 7
SWP B BLANKING AMPLIFIER SHEET 7
TO SWP B MULTI SHEET 2
SWP B INPUT SHEET 2
TO X AMPL SHEET 5
+50V
-50V
+100V
Q8801 2N2369/ DU 14A
Q8802 DU 9A/ 2N869
Q8803 2N2369 DU 14A/
Q8804 DU 2A/ 2N915
Q8805 DU 2A/ 2N915
Q8806 2N2369/ DU 14A



VOLTAGE DATA
1. All voltage measurements were obtained with a 20,000 ohms/volt VOM; all readings are in volts.
2. Preset front-panel controls as follows:

Control	Setting
HORIZONTAL DISPLAY	ARMED ALT
TIME/DIV B	20 mSEC/DIV
TIME/DIV A	5 µSEC/DIV

WAVEFORM DATA
3. Voltage tolerance ±15% with respect to ground.
4. Use Type 4290 Series Probe (X10) and 100 Kc Test Signal.
5. Use Type 7904 Series Test Oscilloscope, DC to 25 Mc.
6. Waveform amplitude measurements are nominal.

HORIZONTAL DISPLAY CHART

Position	Setting	Function
1*	A DLYD	Delayed Armed Sweep
2	ALT (ARMED)	Alternate, Armed Delayed and Strobed Sweep
3	B INTENS BY A	Delayed Strobed Sweep
4	B	Sweep B
5	ALT	Alternate, Sweep A and Sweep B
6	A	Sweep A
7	B INTENS BY A	Triggered Strobed Sweep
8	ALT (TRIG)	Alternate, Triggered Delayed & Strobed Sweep
9	A DLYD	Delayed Triggered Sweep
10	X AMP	X Amplifier
11	B WITH X	Alternate, Sweep B and X Amplifier
12	SINGLE	Single Sweep

* fully CCW

NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.